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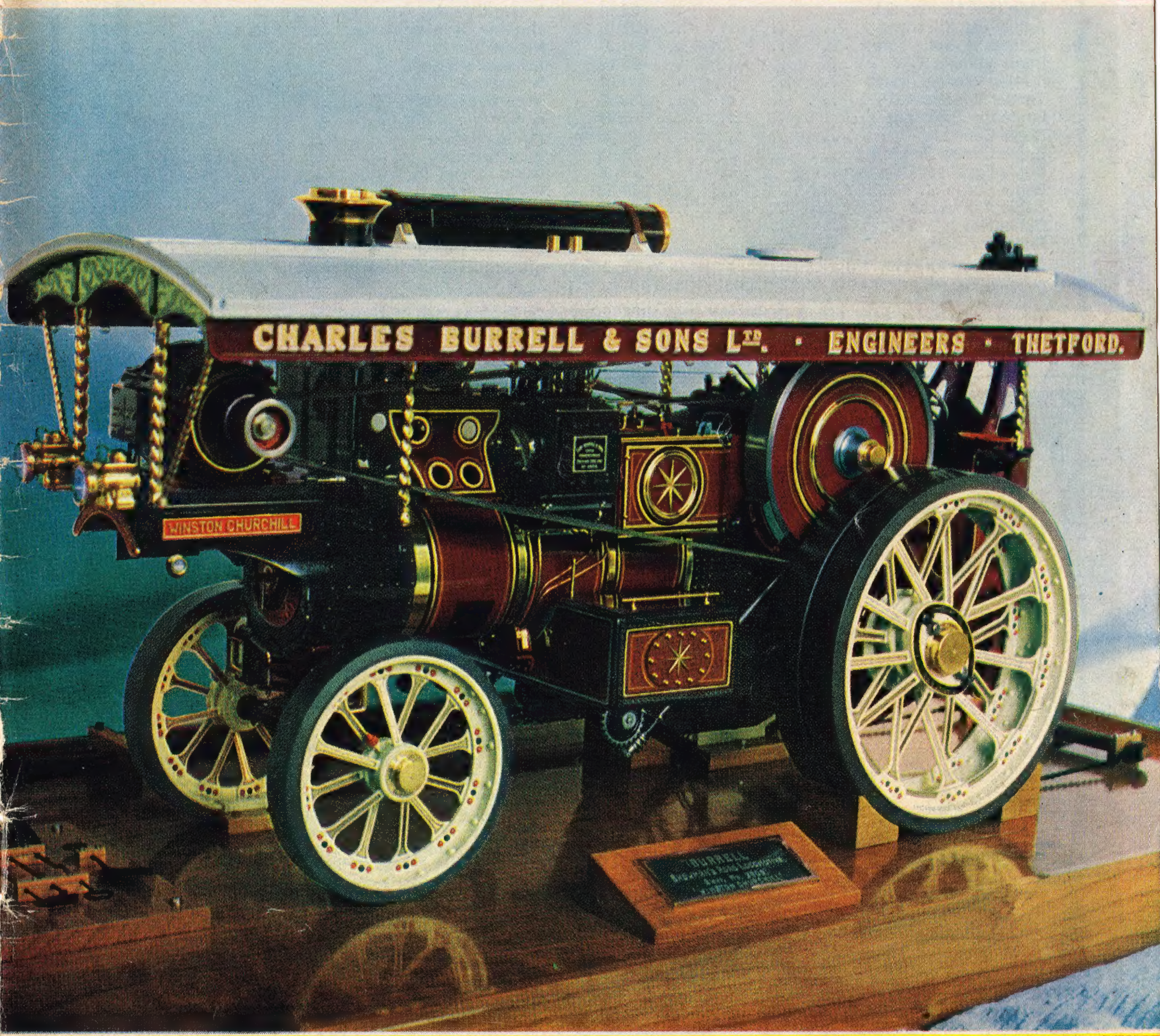

M.E. EXHIBITION—First impressions

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Volume 142 Number 3531

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COVER PICTURE

Cherry Hinds' model Burrell showman's engine, winner of the Championship Cup at the 1976 M.E. Exhibition. Colour photograph by W. J. Hughes.

NEXT ISSUE

The Stanier tender for "Royal Engineer". Further reports on the Exhibition.

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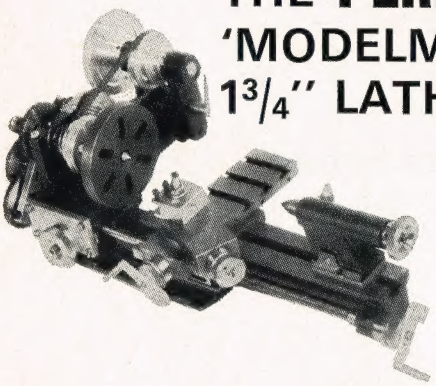
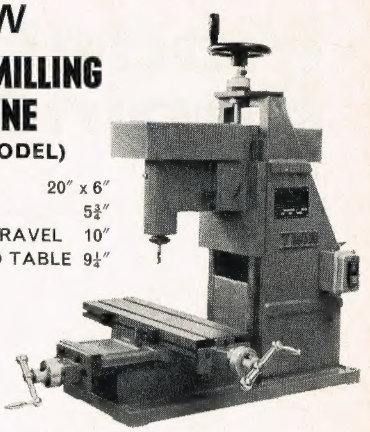
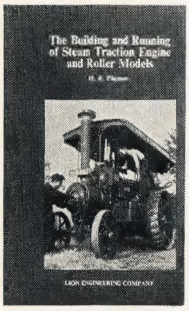


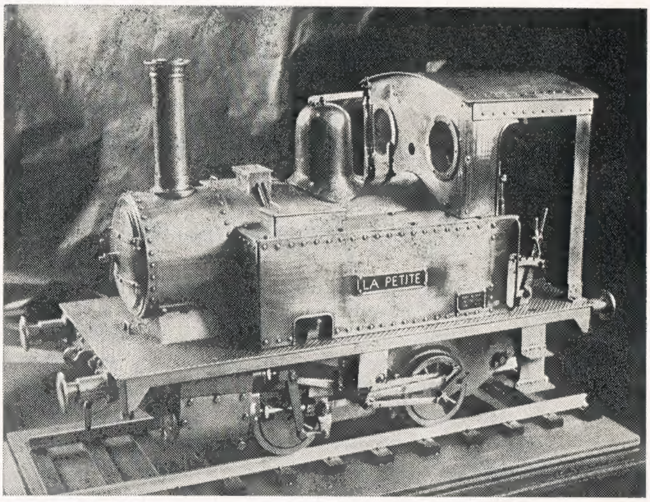




The Building and Running of Steam Traction Engine and Roller Models

SMOKE RINGS

A Commentary by the Editor



Three views of a fine 3½ in. gauge "Tich" built by R. Memin of Paris.

Exhibition at Swindon

The Swindon Group of the Great Western Society are holding a Model Railway Exhibition at the Wyvern Theatre (Arts Centre), Civic Centre, Swindon, on the 2nd and 3rd April. There will be at least ten working model railway and tramway layouts in most of the popular gauges. Static exhibits will include handbuilt items by John Witts of Basingstoke, who will be giving demonstrations of model-building techniques. There will also be a display of railway relics.

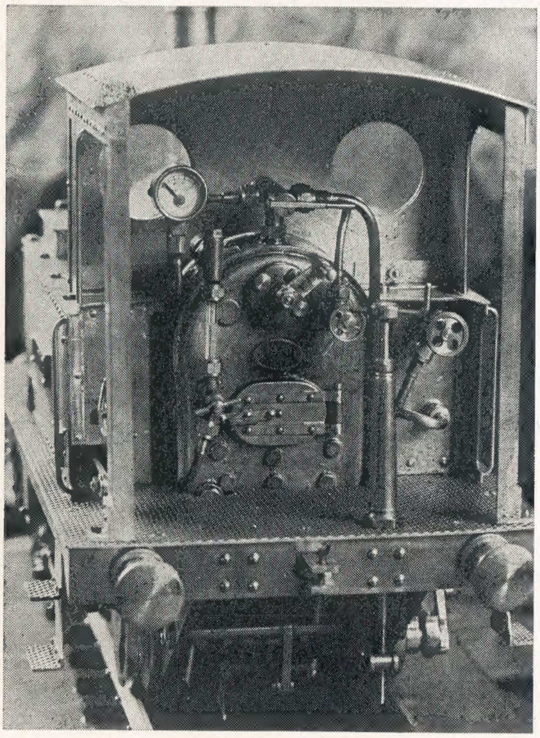
The Swindon Vintage Omnibus Society will be making their ex-Bristol Tramways double-decker bus available, to tour Swindon, advertising the exhibition on the Saturday of the Show. Full details of the exhibition can be obtained from Reg. and Audrey Palk, 5 Bradene Close, Wootton Bassett, Swindon, Wilts.

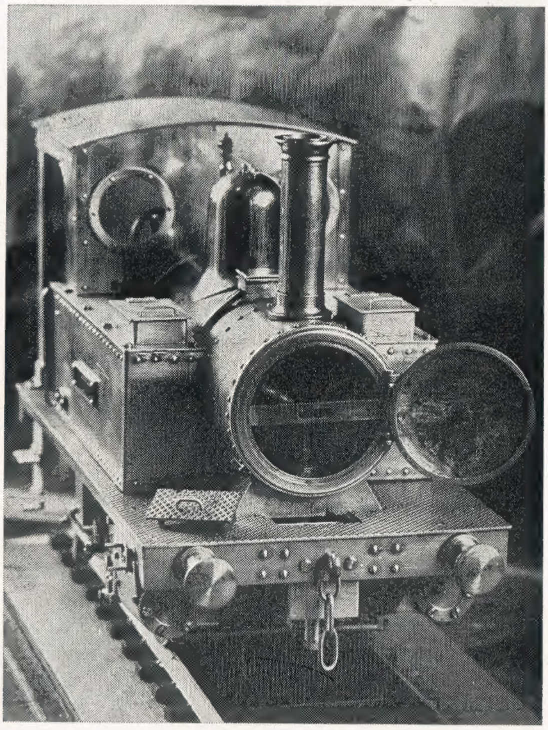
2½ in. gauge

Noel Tyler's letter in "Postbag" this issue makes a very strong case for the 2½ in. gauge. However I do not think he is being fair to those model engineering societies that have no facilities for this gauge. I feel sure that the only reason for the lack of rails for 2½ in. gauge is simply that there are very few 2½ in. gauge locomotives in these clubs, and even less that are in the course of construction. It almost certainly has nothing to do with the expense of laying the extra rail.

At the risk of boring my readers, may I set out once again why, in my opinion, 2½ in. gauge is no longer so popular as the 3½ in. and 5 in. gauges? 2½ in. gauge is much too narrow to give sufficient

Continued on page 188





MODEL ENGINEER EXHIBITION 1976

First Impressions

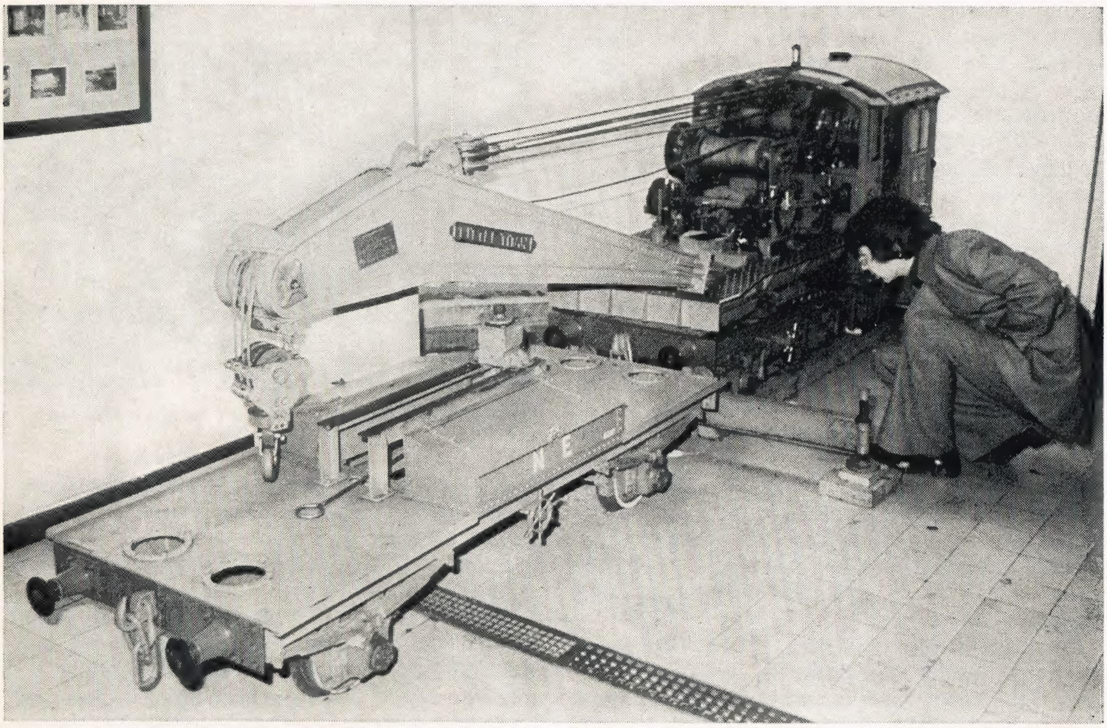
by W. J. Hughes

IT SEEMED QUITE APPROPRIATE that this year, with (to quote the newspapers) "the dawn of a new age for women", a woman should win a Championship Cup at the *Model Engineer Exhibition.* But then of course Miss Cherry Hinds had no need to wait for this "new dawn"—she has done it all before, several times, including taking home the Duke of Edinburgh Trophy. And even the most chauvinist of porcine males could not begrudge this charming lady her success, because she can and does beat us at what is traditionally our own game.

This inch-scale model of the well-known Burrell Scenic showman's engine *Winston Churchill* is a precise and delightful example of craftsmanship (or should one say "craftspersonship" in 1976?), both in the mechanical finish and in the painting and lining. The close attention to detail can be exemplified by reference to the brass headlamps, where the lower ventilation holes—perhaps of 1/32 in. dia.—have each a moulding of half-round section round the edge.

More than this I will not say now, as it is proposed later to devote a separate article to the model, but will just remark that it was awarded the Aveling Barford Trophy as well as the Championship Cup.

But of course the Burrell was only one of many very fine models on view, the general impression being that 1976 will prove to have been a vintage year, with more models of the highest class in many sections than ever before. Amongst the passenger-hauling steam locomotives, for instance,



An unusual attraction was the 15 in. gauge railway breakdown crane by E. Cheeseman. Left-hand page: A general view of the Hall.

there were five Silver Medal winners and two Bronzes, besides four Cups, and in the road vehicles are no fewer than six Silvers and three Bronzes besides the Burrell. And all well-earned, of course — medals don't "come up with the rations" here!

In the road vehicles, R. K. Drury of Goole was not many marks behind Miss Hinds with his very fine 2 in. scale Aveling and Porter Type OA tandem steam roller. Mr. Drury is an authority on what might be termed the unorthodox type of steam roller, and this example is a worthy companion to the 2 in. scale engine which won him the highest awards last year. Unlike that example, with its loco-type boiler and vertical side-mounted engine, the Type OA has a vertical boiler with a side-mounted horizontal engine, and has power steering.

Locomotives

Amongst the locomotives the Championhip Cup was awarded to J. R. W. Heslop of Thirsk for his 5 in. gauge 4-6-4 passenger tank locomotive *Remembrance.* Strikingly finished in grey, with lining and lettering in black and white, the prototype was built by the LB and SCR and named in memory of the 532 men of that railway who were killed in the 1914-18 war. It carried brass plates to that effect, and the model has replicas of these on the tank at each side.

Some ten or eleven years ago, Bill Linfield of London won the Championship Cup and Aveling Barford Trophy for one of the finest Allchin traction engines I have ever seen. He subsequently started to build a $3\frac{1}{2}$ in. gauge *Britannia* which for one reason and another lay idle for a time. Now however he has completed the engine, and at the Exhibition it must have given a great deal of pleasure to a great number of people, as it did to me. The finish is superb, and there is so much fine detail that one can come back again and again to find more. Besides a Silver Medal, this locomotive was awarded the J. N. Maskelyne Memorial Trophy.

From Johannesburg came a big 4-8-2, the 15F Class No. 2937 *City of Capetown* of the South African Railways. The model, built by René Etter, is to 1 in. scale for the $3\frac{1}{2}$ in. gauge, which naturally makes it look even more impressive, and is very well built and finished. It is fitted with both steam and vacuum brakes, and has steam operated reversing gear and sanding gear. A turbo-generator working at 48,000 r.p.m. supplies electricity at 3 volts for the headlight and cab light. The model was awarded a Silver Medal.

As a matter of interest, Mr. Etter and his friend

Arthur Prescott (who is also a friend of mine) are building two 3 in. scale Allchin traction engines between them. But whether we shall see one or other of these big engines over here in the future must remain a matter for conjecture at present.

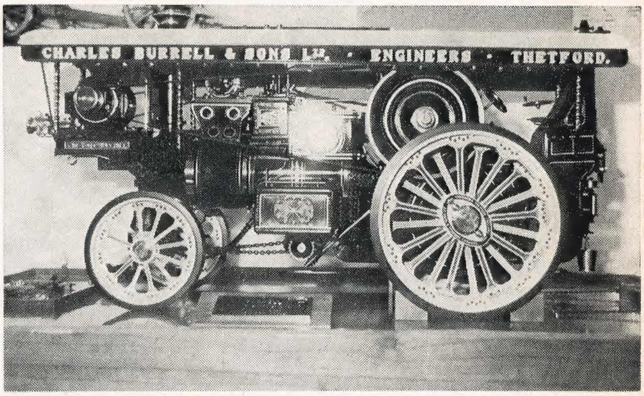
A Silver Medal and the Crebbin Memorial Trophy were awarded to L. A. Saxby of Hillingdon for his 5 in. gauge model of the locomotive *Asia* of the London, Chatham and Dover Railway. The prototype of this 2-4-0 was built in 1837 by Sharp, Stewart of Manchester, and the model accordingly wears all the smart bright trappings of the period, with green upper works and indian red frames, and plenty of polished brasswork.

Another Silver Medal went to C. R. Amsbury for another 5 in. gauge 2-4-0 of the same era. This time it was to the Connor design of 1870 for the Caledonian Railway, looking very good in its nicely lined out uniform of blue. It had the typically neat backhead fittings we have learned to expect from this builder, with two small "C.R." pressure-gauges, twin Salter safety-valve levers and springs, and a handsomely curved regulator handle.

Incidentally how good it is to see these good-looking old-timers appearing in increasing numbers, side-by-side and in contrast with the more modern giants. The *Britannias* and the *Evening Stars* are equally attractive in their own right—especially now that they too are a part of history—but the Victorian (and Edwardian) engineers were able to be less inhibited in many ways and it shows in the furnishings of their masterpieces.

Duke of Edinburgh Trophy

This year no fewer than eleven models were entered for the Duke of Edinburgh Trophy, including two tugs, two destroyers, an aircraft, a loom, a diagonal paddle engine and a beam engine, a twelve-pounder field gun, and two eighteenth century warships. Nobody can envy the



Cherry Hinds' Burrell took the Championship Cup in Class L.

judges who had to choose a winner from such a varied assortment, with every model a previous winner of a high award.

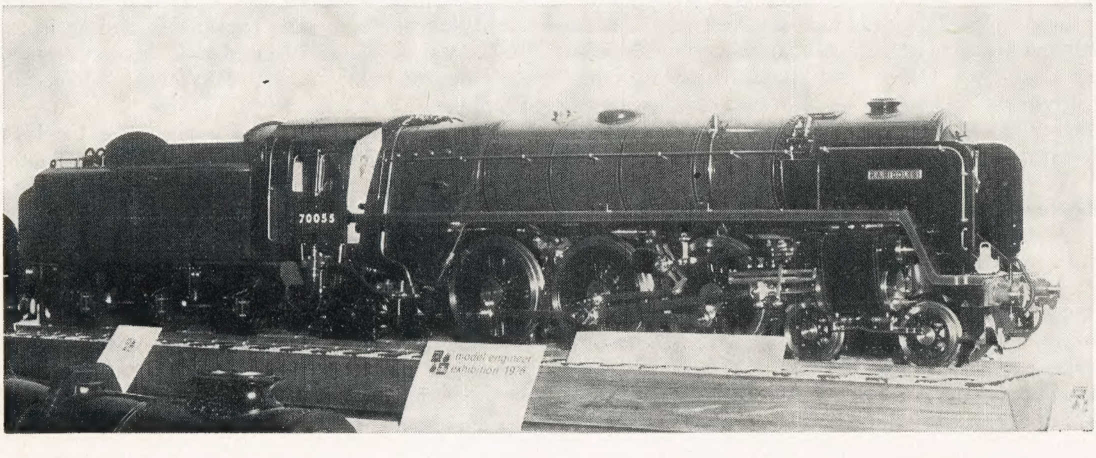
In the event they chose the *Tribal* class destroyer *H.M.S. Ashanti,* built to 1/96th scale by D. C. Brown of London, W.4. At first sight most people thought that this was just a fully-detailed non-working model in a glass case, and certainly it is marvellously detailed as to deck fittings, armament, and upper works. As an extra sample, Mr. Brown had left off for exhibition the external armoured shield of "Y" gun turret, and the complicated traversing, elevating, and ranging apparatus of the twin guns is thus revealed, instead of being hidden as on the other three main turrets.

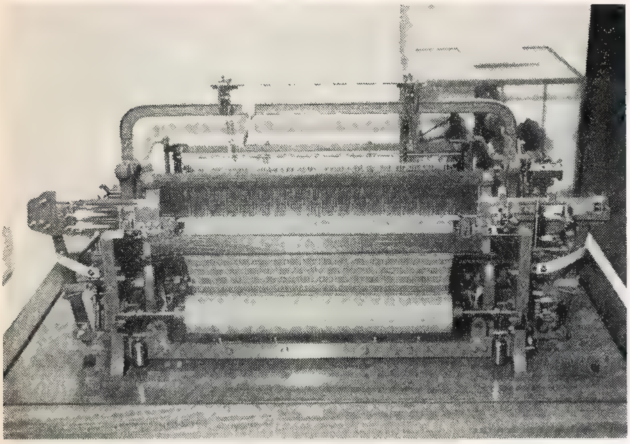
But besides being a fully-detailed glass-case model, this destroyer also is a radio-controlled working model which is sailed regularly. I am not sure of the means of propulsion, but imagine it to be electric.

Some Other Ship Models

Fairly close to *Ashanti* was a $\frac{1}{4}$ in. to 1 ft. model

A very fine $3\frac{1}{2}$ in. gauge "Britannia" by W. Linfield—Silver Medal and Maskelyne Memorial Trophy.





This fine loom was entered for the Duke of Edinburgh section by T. W. Millward.

of H.M. Gunboat *Foxhound* which was on the China station from 1877 to 1884. This model is in fact a non-working historical one, and was built by D. A. Taylor of Newport, Gwent. The armament obviously was much less than on the modern vessels consisting of two 20-pounder breech-loading guns mounted on the deck centre-line and firing to either side, and two Gatling machine guns at bow and stern. There were also nicely-finished deck fittings, whalers, and other detail. The H. V. Evans Trophy was awarded to this gunboat.

Amongst the "working yachts and sailing ships" the Championship Cup was won by T. E. J. Manning for his French paddle steamer *Le Sphinx,* also to ¼ in. scale. And if it seems a contradiction to call this a sailing ship, it should be explained that the vessel was fully rigged, of the 1820 period, with auxiliary machinery only. In the model, which is about 4 ft. long, the hull is planked in mahogany, clad in rolled copper simulating plating. A tall copper funnel with ornamental top is a prominent feature, and there are eight 32-pounder guns and four anchors. The paddle wheels are driven through worm gearing by an electric motor.

In the same class, and about the same length, was a ½ in. scale eighteenth century Chinese trading junk by J. D. Bloom of Colchester. This too was nicely detailed, and had three masts with the usual well-slatted sails of the junk. It won the Maze Challenge Cup.

Amongst the miniature model ships, it is always a pleasure to look out for those built by D. Hunnisett of Aylesbury. This year we had three of them, one being his entry *La Superbe* of 1785 for the Duke of Edinburgh competition. I have remarked before that one of the good things about this award is that it gives us a chance to examine for a second time the classic models of former years, which *La Superbe* certainly is. In the delicate miniaturisation of 50 ft. to 1 in., one could do really with a powerful magnifying glass to enable ordinary eyesight to do justice to Mr. Hunnisett's work.

Mr. Hunnisett was not successful in the Duke of Edinburgh section, but it must have been a large compensation that he won the Championship Cup and a Silver Medal in Class I for his other two models, respectively the 84-gun English *Royal Katherine* of 1664 and the U.S.S. *Washington* revenue cutter, a brig of 1837. Both of these were to the same scale — 1/600th of full size — as *La Superbe,* and were full of the same marvellous tiny detail work of rigging, guns, and deck fittings.

In the same class too, I particularly liked a model by E. P. Heriz-Smith of Orpington, who was awarded a Bronze Medal for his 1/192 scale seventeenth century shipyard scene. Here we had a slipway on the bank of a river, with the hull of a wooden ship on the stocks and nearly ready for launching, with scaffolding, timbers, and other paraphernalia necessary to the trade.

General Engineering

Not many exhibitions go by without a nice marine engine to look at, and this year's was no exception, with that of A. G. Hann from Cornwall taking the Championship Cup. As this honour implies, the model was beautifully made and of first-class quality. It was a triple expansion engine of fairly modern period, with a piston valve to the high-pressure cylinder and slide-valves to the intermediate and low-pressure ones. The crankshaft was in three pieces, joined by bosses with through bolts.

As usual, the condenser and pumps were at the rear, and so was the steam-hydraulic gear for reversing. The barring-gear for turning the engine by degrees consisted of a wormwheel with a worm which could be slid into engagement, and operated by means of a ratchet lever. The model was built to 1/16th of full size.

The Bradbury Winter Memorial Cup and a Silver Medal were awarded to A. Walshaw of Kendal for his nine-cylinder 100 h.p. Gnome rotary engine. Built to 1/5th scale, this model involved some quite delicate work, particularly in turning the very thin finned cylinders from the solid, and in fabricating other parts.

W. U. Hancock of Haslemere had modelled a very unusual electric generating set with its auxiliary plant. The prototype was one of a pair used in a small power station in South Wales early in this century. These had a two-stroke I.C. engine running on producer gas, and each engine drove a 1000 volt 83 cycle alternator with a separately driven 50 volt d.c. exciter.

The model runs at 320 r.p.m. on two-stroke petroil mixture. It has two vertical working cylinders, and much other detail including pumps and

valves, as well as the alternator and the exciter with open commutators and switch gear. It was well finished and very educational and surely these are attributes to which any modeller may aspire.

Close at hand was another entrant for the Duke of Edinburgh Trophy, a diagonal paddle engine for the paddle steamer *Isle of Arran*. It was to half-inch scale, but with a single cylinder instead of the perhaps more common compound. As common in diagonal paddle engines, the condenser and pumps were beneath the sloping guide bars and motion. Steam operated reversing gear was fitted, and the model was built by R. K. Moore of Haverhill. It was runner-up to the winner of the Trophy.

Other Work

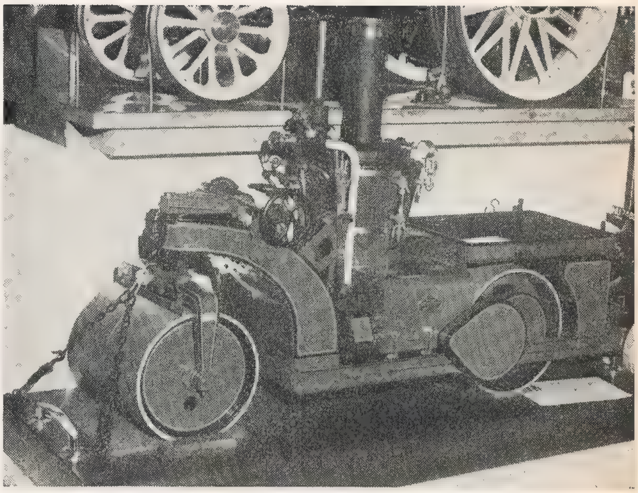
The horological exhibits almost invariably are of a high class, and this year especially so, with seven of the nine entrants receiving respectively five Silver Medals, and two V.H.C's. The highest marks were awarded to Dr. B. M. Frost-Smith of Penrith for a very lovely carriage clock, but perhaps the clock to attract most attention from the general public was B. Elliott's astronomical clock, designed by himself. This clock has seven dials, telling the time in seconds, minutes and hours, and giving the day, date, month, and phase of the moon. It has a gravity escapement, and a fusee drive with chain from the spring barrel. A lovely piece of work indeed.

On the S.M.E.E. stand there is always plenty for the connoisseur to examine, besides the perhaps more common stationary engines which—equally well made—tend to attract the crowd by being at work under compressed air.

For example, C. W. Tidy's fine inch-scale beam engine is now approaching completion. The prototype was built about 1870 by Easton and Anderson Ltd. for Banstead Hospital. It is a single-cylinder engine with cast A-frames and a double plate beam, and the model has very full detail including gib and cottered brasses on the connecting rod and the parallel motion. A pleasing feature is the handrail stanchions, which are turned taper with two balls each. At the narrowest the stanchions are about 3/32 in. dia., so it would need some nice work to turn them from the solid.

Also much admired on the S.M.E.E. stand was the $3\frac{1}{2}$ in. gauge L.N.E.R. tender—or rather the base of it—which is being built by G. H. Thomas. It was displayed upside down to show the tremendous detail which is exactly to prototype drawings. It includes water pick-up gear, and correct suspension with Spencer rubber springs, and automatic vacuum brakes. The journals run in axleboxes which have removable keeps, oil pads, etc.—each box has thirteen metal parts and nine fastenings.

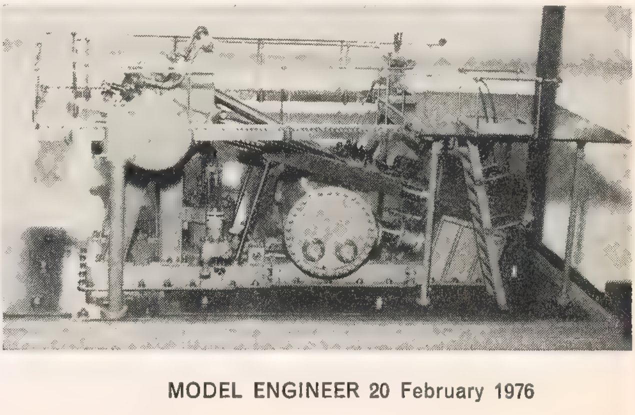
On this stand too was an exhibit which particularly pleased the vast number of children who had seen it on the "Blue Peter" television programme. Quite simply it was a *Theseus* engine to the Westbury design, with a half-sized *Theseus* at its side, and another quarter-sized one again on the same plinth. These engines, built by H. C. Roughton, were amongst those working on air pressure.



An Aveling & Porter tandem steam roller by R. K. Drury of Goole won a Silver Medal. The entries in Class L were the best for many years.

And finally a brief word about the smaller locomotives, of which invariably several are delightful. In 7 mm. scale—Gauge "O"—two which caught my eye were Adams locomotives of the L.S.W.R., a 4-4-0 express and a 4-4-2 radial tank, both by J. Brierley of Hove. Another in the same gauge was J. S. Bremner's G.E.R. 4-6-0 and in the same scale but not the same gauge was P. R. Horton's G.W.R. broad gauge locomotive *Vulcan*. All these were winners of silver medals, and Mr. Horton also took the Model Railways Bowl and Mr. Bremner the H. C. Wheat Challenge Cup.

This fine diagonal paddle engine for the P.S. "Isle of Arran" was runner-up in the Duke of Edinburgh Section. It was built by R. K. Moore of Haverhill.



A GEAR-CUTTING MACHINE

Part III **by T. D. Jacobs** *From page 121*

The ½ in. holes for the pulley shaft should also be finish bored with a bar between centres; no bushes are specified, the aluminium alloy bar supplied by *M.E.* advertisers has proved to be a good bearing material. The pinion should be as small as possible, a 20-tooth one is shown as that is likely to be the smallest Myford changewheel; a smaller one can be made when the machine is finished. Mine has 13 teeth but this means it has to be screwed into the end of a ½ in. shaft. The large reduction ratio is to enable a good torque at the cutter to be obtained from round plastic belt "for light drives only". Any reasonable sized pinion can be accommodated by varying the thickness of a packing block between the bracket and the main head. The pulley is a standard die cast product, obtained from advertisers, and fits on either end of the shaft, one end for hobbing spur gears, the other for thread milling, spiral bevel cutting, etc. The various collars cater for the endwise location of the shafts, etc.

The two 2 BA holes at the end of the base plate are for an outboard bearing. I made one but it hasn't been necessary yet. After all, most work on a lathe, and nearly all on a vertical milling machine, is done with the work or cutter overhanging the bearings.

Cutting straight tooth bevels

The method used is as described by Martin Cleeve in 1966 and the additional items required are Nos. 81 to 87. The graduated extension piece is quite a straightforward turning job, and the graduations are put on in the same way as

Fig. 5: The spring box screwcutting tool and gauge.

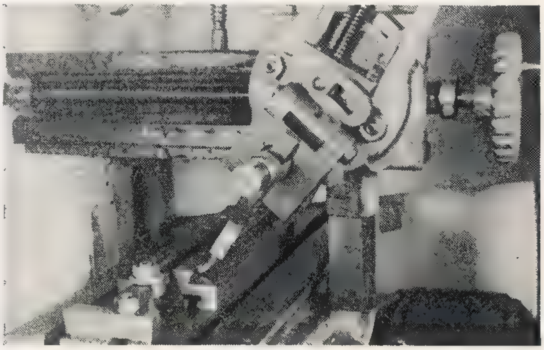


Fig. 6: The planer finishing the dovetails.

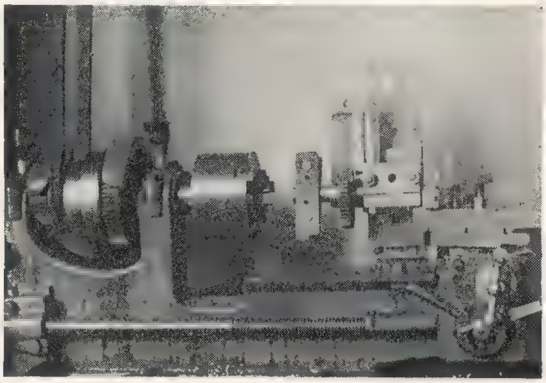


Fig. 7: The vertical slide set up for graduating the dials.

Left. Fig. 8: Close-up of dial graduating.

described earlier for the dials, using a long 5/16 in. dia. work holder to screw into the end of the arbor, and mounting the vertical-slide carrying the work head etc. on the bed of the lathe. Personally I prefer graduations fairly widely spaced and find it

Fig. 9: Cranked spring tools for turning ball handles.

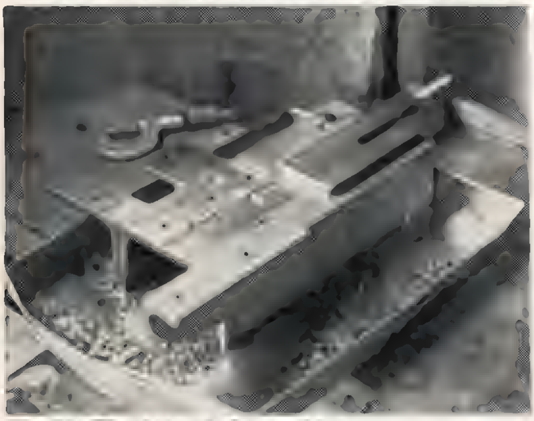


Fig. 10: The base of the machine.

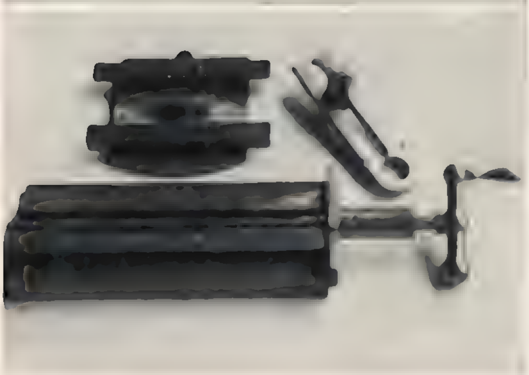


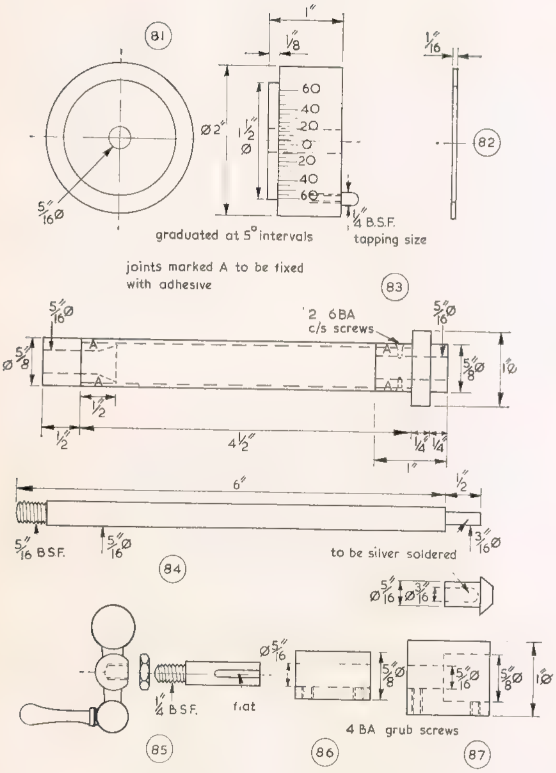
Fig. 13: The cross-slide assembly.

Fig. 14: Cutting a straight tooth bevel.

On left—Fig. 11: The longitudinal slide from below.

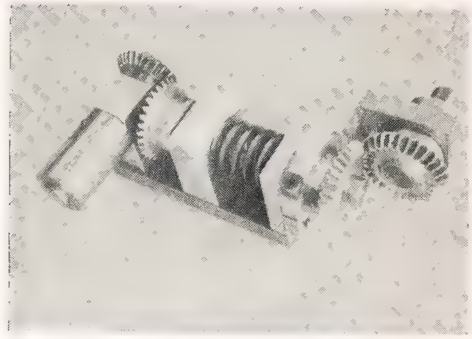
Bottom left—Fig. 12: Sub-assemblies of the cross-slide.

easier to estimate 1/5 of 5 deg. apart graduations than to count very closely spaced lines. 5 deg. spacing can be obtained by having a 60-tooth wheel on the arbor and a 6-tooth ratchet disc on the wormshaft, and moving five of these teeth for each line. The peg in the base of the extension should be in such a position that when it is engaged in one of the $\frac{1}{4}$ in. BSF tapped holes the gradua-



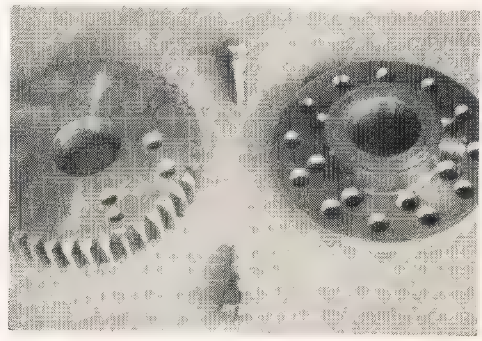
COMPONENTS FOR CUTTING STRAIGHT TOOTH BEVEL GEARS

Right: Fig. 15



The index worm carrier with bevels for gearing to feed screw and for power feed via universal shaft.

Fig. 16



Index wheel, division plate and 2 index pins.

tions can easily be seen. The fiducial line can be put on the curved surface of the work head by setting a $\frac{5}{8}$ in. bar in the work head accurately level, with the vertical-slide clamped to the M.O. slab.

To get the tapping hole for the peg in the right place, bolt the work head and extension together with a 5/16 bolt, or stud and 2 nuts. Then on a good drilling machine that drills square, drill $\frac{1}{4}$ in. about halfway through the extension through one of the $\frac{1}{4}$ in. holes already in the work head. Change to a 5/32 in. drill (2 BA tapping) and go right through. Tap 2 BA from the back about $\frac{3}{8}$ in. deep and fit a specially made peg, turned and screwed 2 BA for about $\frac{1}{4}$ in. and plain turned at the same setting to be a good fit in the $\frac{1}{4}$ in. BSF hole, probably just a little larger than $\frac{1}{4}$ in. BSF tapping size.

The hollow work arbor is made by the built up technique, because I find deep drilling a very tedious job. The centre section is $\frac{5}{8}$ in. dia. 18 gauge seam-welded tube, and should be lapped with the split aluminium lap to a running fit in the work head. The drawbolt has a silver soldered head to save material; it can be turned from solid if preferred.

The bevels are cut as described by Martin Cleeve; briefly a fly cutter is used, like a screwing tool but $47\frac{1}{2}$ deg. included angle, and tip radius about 1/64 in. The blank is made with the angle face at 47 deg. and is cut with the work head set at 43 deg., thus making the spaces deeper at the heel and correspondingly wider so that the tops of the teeth taper slightly.

The ball handle and two adapters shown (No. 85) are not essential but are useful accessories. The adapters enable the ball handle to be fixed to the end of any 5/16 in. or $\frac{5}{8}$ in. shaft; it can be thus fixed to the end of the work arbor when plain indexing direct from a change wheel.

It is probable that when the equipment for making spiral bevels is done (to be described later), not many straight bevels will be made, as the spiral ones are not only better but easier to do. However a pair are required for the spiral bevel set-up and a special pair for thread milling.

Thread milling

With the Cutter Headstock secured in its right angle position (at right angles to the longitudinal-slide) and the cone pulley on the back end of the drive shaft, the machine is immediately set for thread milling. The work arbor is connected to the feed screw by change wheels to give the pitch required and the cross-slide set to the helix angle of the thread. The cutter should be $1\frac{1}{2}$ in. dia. to enable the work to pass over the headstock, and

until the back centre (to be described later) is made, only short worms, hobs, etc. can be milled as they are overhanging the work arbor. Left hand worms require the bell chuck type work arbor (No. 91); it will be noted that the collar is shown shrunk on to the arbor in this case. This is, I think, as good a method of securing it as any, but the prime reason for adopting it was one of nostalgia! Many years ago when I was a young assistant foreman in the Royal Gun Factory, I was responsible for shrinking together the components of heavy guns and I thought I would like to have another go at the shrinking technique. One of the regular jobs was shrinking the jacket on to the "A" tube of 6 in. guns. The "A" tube was 25 ft. long and weighed two or three tons, the jacket was about 12 ft. long and weighed over a ton, and for design reasons there was an interference fit of 20 thou. or so, so it was not child's play. However the technique was well thought out and by keeping calm and deliberate (but not slow) while actually doing it there was never any trouble, on this particular job anyway.

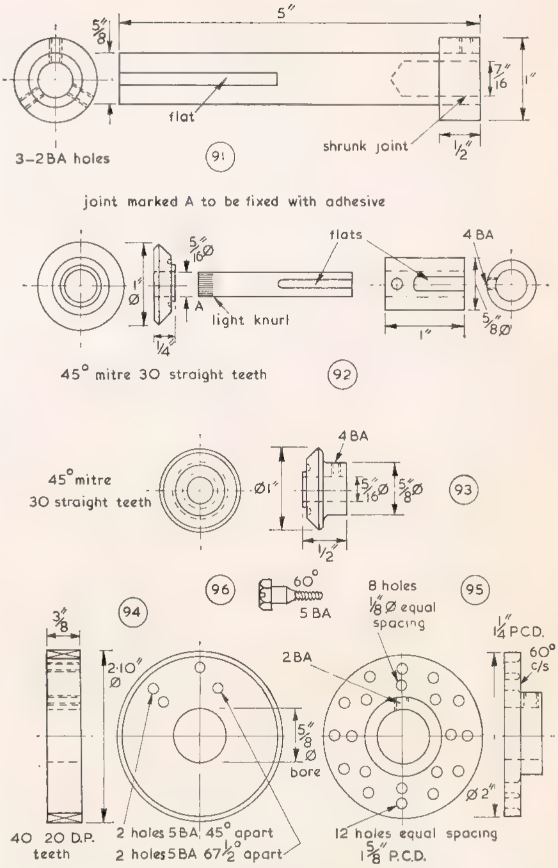
Not so with the collar on my work arbor; I made it much hotter than we were allowed to make the 6 in. gun jackets, and the interference was only a thou. or so, but it went on slightly out of line, grabbed hold before I could get it off, and there it was, stuck for good! An extension adapter for $\frac{5}{8}$ in. shaft was made out of this effort, and a second go was successful, but the interference was cut down to a few tenths of a thou., and the collar was made bright red hot before putting on.

The direct coupling of work arbor and feed screw by change wheels is only practicable when the pitch being cut is not far removed from the 1/16 in. pitch of the feed screw. The arrangement of bevel wheels is to enable this change wheel connection to be made via the index worm and wheel. The bevel wheel shaft uses the cross bearing block on the worm carrier, the purpose of which may have foxed builders up to now! Space is very limited in this region which is why the bevel is very thin and "back to front".

To fix it to the shaft, first make it with a boss at the back, like the other bevel, grip this boss in the S.C. chuck on the lathe, and the 5/16 in. shaft in the drill chuck, knurled end out. Anoint this knurled end with adhesive and push it into the bevel with the tailstock hand wheel. When the adhesive is thoroughly set, grip the shaft in the three-jaw and face off the boss at the back of the bevel.

To cut multi-start worms, the index worm wheel, division plate, and pin are required, 94, 95, and 96. The division plate is plain turning except for the holes for the dividing pin. These are done as follows.

Set up the vertical-slide carrying the work head on the boring table of the lathe with the work



COMPONENTS FOR THREAD MILLING

arbor parallel to the lathe axis. Put a 24-tooth (or better, a 48-tooth) change wheel on the back of the arbor and the division plate being worked on on the front, and rig up the pawl. The 24-tooth or 48-tooth wheels will probably need to be made for the job but it will be practice in gear hobbing and they will often be useful. Then with a medium-sized centre drill in the S.C. chuck and a saddle stop rigged up to get constant depths, index round for 12 holes on the correct pitch circle dia., the centre drill should go in far enough to make the mouth of the holes about 3/16 in. dia. Change to a $\frac{1}{8}$ in. drill which cuts nicely to size and index round again going right through this time. Without shifting anything else change the division plate for the index worm wheel. Spot this with the centre drill, drill 5 BA tapping size and tap with the tap held in the lathe chuck. Index $1\frac{1}{2}$ twelfths of a circle (3 teeth on the 24-tooth wheel, 6 on the 48) and repeat. Thus we get up to 24 divisions by drilling only 14 holes.

The 8-hole ring is done in an exactly similar way using a 32-tooth wheel for indexing. These two rows of holes give 2, 4, 6, 8, 12, 16, and 24 divi-

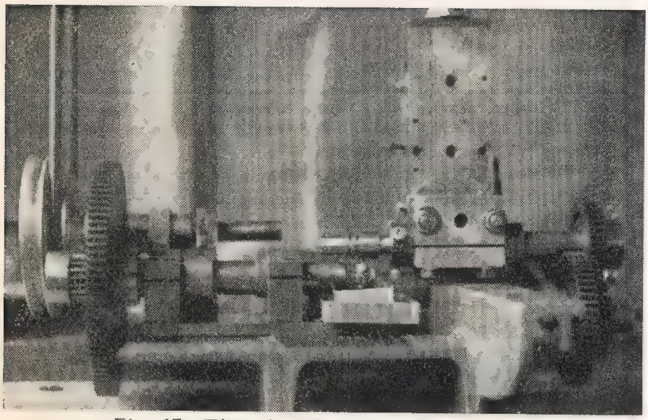


Fig. 17: Thread milling a single-start worm.

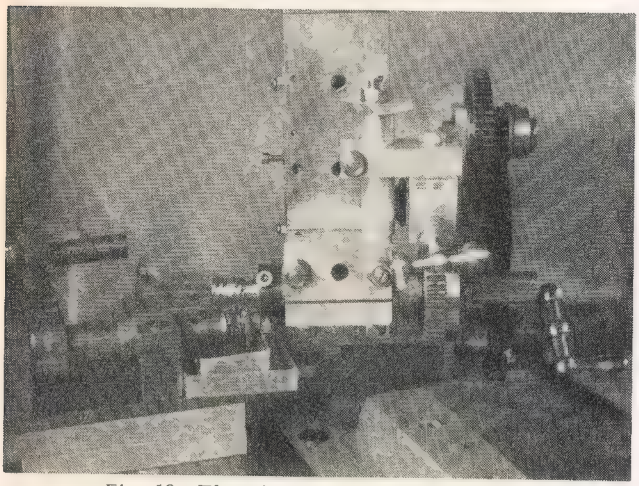


Fig. 18: Thread milling four-start worm using hand feed.

sions; new division plates can be made in a similar way if and when other divisions are required. By the way, take great care to have any backlash always one way when doing this indexing, and tighten the pinch nuts before each drilling.

With this equipment made, it will be very useful to make a 4-start worm and a 32-tooth worm wheel to use as index worm and wheel on the machine, giving something intermediate between direct change wheels and the 20 to 1 ratio which is about the lowest that can be obtained with a single start worm. The pair which I have made so far had a ½ in. dia. ½ in. lead worm and a worm wheel of aluminium about 1½ in. dia.

To make the worm, turn a blank with a ½ in. dia. length for the worm 13/16 in. long in the centre, and projections ⅞ in. long at each end, 5/16 dia. one end, 7/16 in. dia. the other, this to fit the bell chuck. This 7/16 in. will later be turned down to 5/16 in., so make it between centres. The thread milling cutter should be 1½ in. dia., have

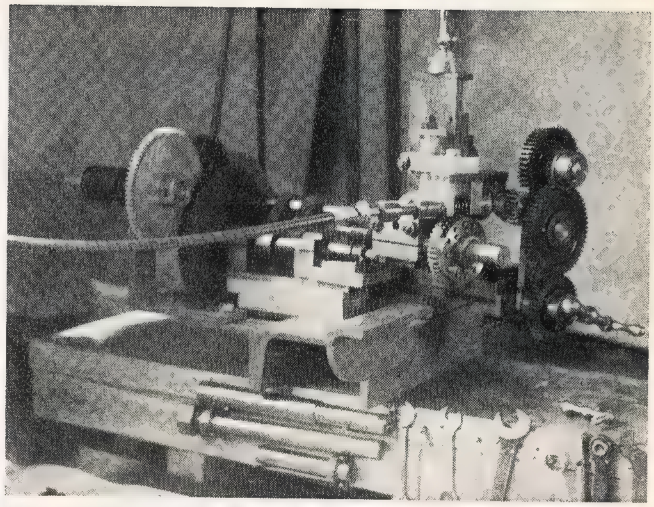


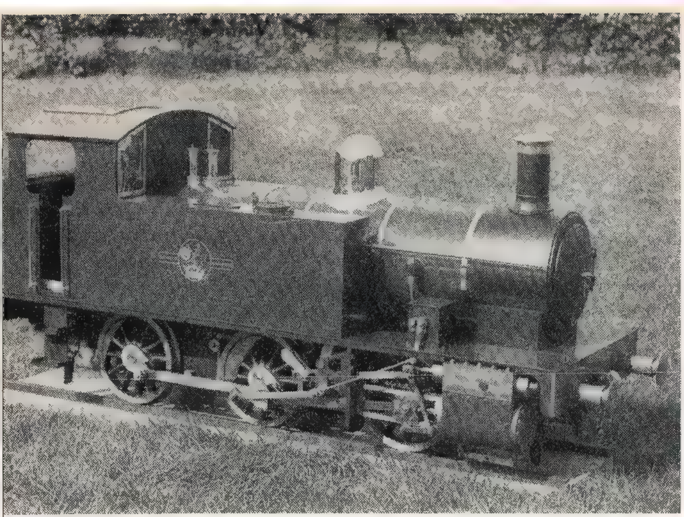
Fig. 19: Thread milling four-start worm with power feed via flexible shaft.

14½ deg. flanks and be .040 in. thick at the tips of the teeth. Eight to ten teeth will be about right and they should, of course, be form relieved if possible; if not carefully file relieved as already described. A plain milling cutter is easier to relieve in this way than a hob.

Set the cross-slide to 20½ deg. (the helix angle) and set up change wheels (via the bevel gears) to give ½ in. pitch, with an idler for a left hand worm; 20/50 x 30/60 x idler will do; the long banjo will be required. The axial pin will not be needed in the cutter which should be mounted, by means of a carrier, in the end of the cutter mandrel. The index pin should be in one of the 12-row holes. The depth of the threads is .085 in. and two cuts will be wise, say .055 in. and .03 in. Feed can be by hand with the ball handle (85) on the end of the index worm shaft or a power feed can be rigged up from a second set of change wheels on the bracket (71) bolted alongside the cutter headstock. I used a flexible shaft to transmit the feed drive at first, but now use the bevel bracket required for spiral bevels, and the universal shaft; a long ¼ in. square section will be required for this application. All four starts should be done with .055 in. cut, indexing 3 holes between each, and then all four to full depth.

Now for the hob. Turn between centres a blank of b.m.s. (yes, a case-hardened hob does fine for occasional use) like that for the worm except that the 5/16 in. end need only be ⅜ in. long for a lathe carrier later. Cut the threads in just the same way but make them .90 in. deep. I made the mistake of gashing my hob parallel to the axis and although it cut a useable worm wheel, one flank of the teeth was more pushed than cut.

To be continued



ANOTHER "SIMPLEX"

by Donald A. Amey

THE OBJECT of this article is to encourage the faint hearted, inspire the idle, confound the "scoffers" and shock the "experts"!

It was some two and a half years ago that our Club pushed on with a permanent track, and I realised that I would have no locomotive to run. I asked around my M.E. friends and received suggestions that ranged from *Tich* via *Maisie* to a 5 in. gauge *Nigel Gresley,* and some suggestions that with my technical skill I should take up golf. It was the last remark that I found the most cutting and for one's "friends" to infer that one is incapable of doing a thing, that makes one more determined to do it. (I would suggest at this point that professional (?) engine builders and those who have done it before, turn to another page or go and mow the grass at the Club track.)

After advice from the Moseley Road gang I decided to "have a go" and *Simplex* was the objective for a number of reasons.

1. The name lulled you into a false sense of early achievement.
2. Being 5 in. gauge, watchmaking should be at a minimum.
3. The 0-6-0 layout would be ideal for hard work on the track.
4. The drawing showed a locomotive simple in outline and design, and free from the O and S's that seem to bedevil other designs.
5. The series of articles in *Model Engineer* by Martin Evans were clear and understandable (by the way we are not related).

This article is not a story of how each hole was drilled or which complicated jig taking weeks to produce was designed to machine this or that part, but a run down on a few of the snags I met and some of the stupid mistakes I made, so that anyone like me who is having a go might save a few hours of wasted labour and many hours of frustration.

As the good book says, we started with the frames, no snag here, the usual procedure of marking out as a pair, except that mine "sprung" when cut. A flat surface, a rubber mallet and across one's knees corrected this.

Fitting the horns caused a few tears, remember to put a block between the cheeks before riveting, otherwise they will close up (I know it's beginner's stuff but we all have to start somewhere and I am certain that the Club grass needs cutting). The next big job was linking up the frames. I do not possess a surface plate and my lathe bed is too small, so I decided that a piece of plate glass was the thing—beware, $\frac{1}{4}$ in. plate glass twists and so did my frames.

Quartering wheels, how did we manage before Loctite? There was an article in *Model Engineer* some time ago using the chuck jaws and a bar held in the tool post—it works.

Coupling rods next; as I was not too happy regarding complete accuracy on frame alignment, I decided to play safe and make centred plugs for the holes in the axleboxes, and then measure the centre of the rods using dividers, as I expected there was a variation between sides, the rods were therefore made accordingly — by the way when making the rod ends I managed to plough off one of the oilers so I had it made up with a bit of weld—it then cost me three drills before I could get through the hard spot, to make the oil ways.

Cylinders — no undue problems except tapping all those holes, the tapping and staking machine at present being described would have earned its keep. The cylinders went according to the words and music except that I have fitted O rings again as per a *Model Engineer* article. Time will tell if some of the tales one hears about O rings are true. Valve gear next, again as per Martin Evans, my only advice being here, take your time, measure twice and cut once. I tried to save a bit of cost by using a piece of black iron filed up. DON'T! I know it can be done but it is far nicer to work in the bright stuff, and you get a better finish. In the past I have not been very successful with case hardening, anyway it spoils all the draw filing on the bits and pieces, so I set to and bushed the lot. Expansion links—again stick to the words. I tried to end mill out the whole slot at one go. If anyone wants five oversize expansion links for *Simplex* I can supply.

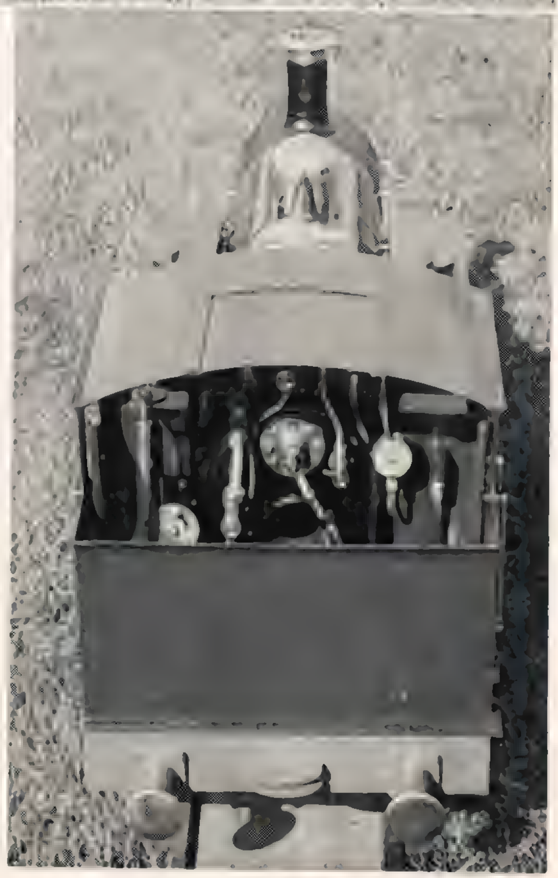
At this stage and in order to cheer myself up and show to my wife that at some time the machine might work, I connected to the air line, but nothing happened except a lot of escaping air. I turned the wheels by hand, forgetting to turn off

the air line. It burst into life, taking my fingers with it. There is a moral here somewhere.

After a delay for the wounds to heal, I considered the Boiler, yes the Boiler. There are more harrowing tales told about Boilers in Model Engineering Clubs and letters written to *Model Engineer* about this subject than enough. I must stress I am in no way decrying all attempts to arrive at and maintain a high standard of boiler safety and to this end it must be brought home to everyone who has not the necessary knowledge that they should stick slavishly to the music, and only then to the music of a tried and trusted composer.

Having said that little piece, boiler building is not as daunting as first thought. I tried the open ended firebox method as set out by Mr. Spink but also had the considerable advantage of some verbal help from Alec Farmer and apart from a little Comsol on the odd pin hole it withstood a hydraulic test.

Having read the article which casts suspicion on the strength of the *Simplex* boiler, and as our own Club was at that time formulating its boiler test procedure, we went the whole way. We pumped it up to 250 lb. per square inch with cold water and held it there for a full 30 minutes. After this drastic test, as far as we could see nothing moved; we did not, I agree, use the test rig with dial gauges, but also I am no expert boiler maker, thus I feel there cannot be much wrong with the design or safety margins used if it will take that test.



With the boiler ready to fit we come to the paint or not paint decision. I decided to join the former group and I think it is the best course, so frames, wheels, smokebox got duly done. There is a considerable amount of psychology about building locomotives and it was about this time in the construction that one feels that it is going on for ever; somehow a bit of paint makes you feel it is well on the way.

I suppose you are really about half-way home at this stage. Then you start on the platework, that is after you have negotiated a bank loan to pay for the sheet brass! I have been unable to find out at this stage what I did wrong, but I cut the running boards out, tried them in place and found the cylinders fouled the valance. Either I had made the cylinders too wide or the running boards too narrow or the buffer beams too short, so I have the only *Simplex* in captivity with pieces cut out of the valance to accommodate the steam chests. If it is a drawing fault I am not suggesting we join the ranks of those who blame the draughtsman, but I would like to know what went wrong.

We pressed on with the platework and I have found the advice a little scanty; one snag is that I made the ashpan as per drawing, then it had to be cut in half and hinged to allow it to fit.

Regarding side tanks, sides, roof and spectacle plate, I made these as one unit which is held to the running boards by four 2 BA bolts. By the way, I wish I could ask LBSC how to roll a lagging sheet over a beer bottle. Obviously I was using the wrong brew.

I will skip the plumbing and where not to put the pipes as this is a matter of personal choice and we received no guidance from the drawings, and come on to the painting. Painting: reams and reams have been written on this subject and there is only one comment I would make, that is, do not change the make or type of paint half-way through. I did. Synthetic enamel paint does funny things to zinc chromate primer so we had to start again.

This concluded the building and since then it has been steamed and it works! It really works! There is only one snag, it won't go in the car so we are now fixing up a trailer so that we can take it to the track. There must be something to be said for $3\frac{1}{2}$ in. gauge.

P.S. Steam in this model has become an embarrassment, we can't stop it blowing off. If anyone can tell us how to stop *Simplex* steaming like mad after working on a continuous track for 3 hours virtually non-stop please advise Stafford Model Engineering Society.

JEYNES' CORNER

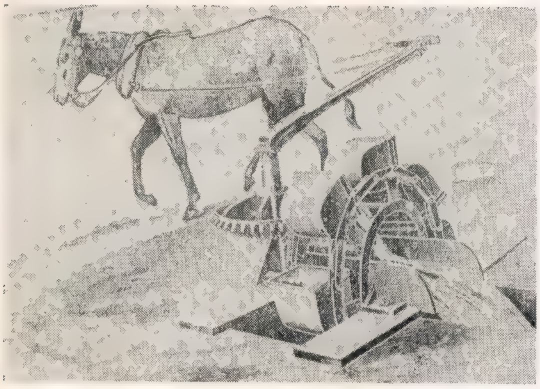
E. H. Jeynes writes about Horse Gears

BEFORE THE ADVENT of steam power on farms and collieries, motive power for driving such crude machinery as existed, pumping, and winding coal and ore to the surface at mines, was provided by animal power, except where waterwheels and windmills could be employed, the heaviest tasks by horses, and the lighter tasks by dogs.

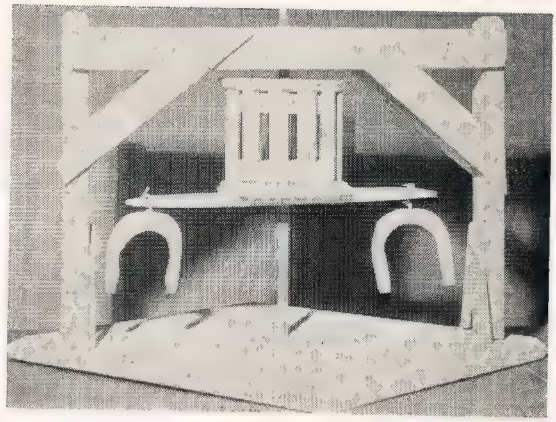
Mr. Frank Woodall's photograph of a model of an early colliery winding gin gives a good idea of the principle used for a winding gin or whim, the horses walking in a circle round a vertical shaft which carried the drum. It is pretty obvious that some kind of braking would have to be arranged to hold the weight of the rope, and any load being lowered down the shaft. I do not think the braking could be effected solely by the horses, so some crude type of band brake was possibly used, such as a couple of turns of rope round the drum, fastened to the frame at one side having means of tightening it, after the manner of brake testing. Another manner of brake could well have been frictional by means of wood blocks acting on the drum. I have examined a model made by Mr. G. B. P. Piggins and this has no brake, but the method of attaching the horses is different from that shown by Mr. Woodall; it would appear that the sweeps in the North East had two short vertical shafts, as in Mr. Piggins' model, these being termed "Starts".

The Gin or Whim was in common use on farms in the North East; in the early types the gear wheel, its supports and the horse beams were overhead with respect to the horses, and generally, a single storey building was provided to house them, usually built on to the barn. These wheel houses were round, square, or polygonal and formed an easily identifiable farm building. A recent investigation shows that 562 possible sites for horse wheels can be noted from the Ordnance Survey Sheet for Northumberland, so it is quite possible that there were many more originally. Out of all the number however, it seems there was not a single one complete, the cast iron gear wheels probably going towards the war effort. The most complete one is however to be preserved; this was at Berwick Hill, Low House Farm, South Northumberland, and was examined by three friends of mine, keen archaeologists, who found that all the major components were numbered, pointing to the possibility that the horse-wheel had been prefabricated and marked by the builders to allow of easy re-erection. The date 1814 was carved into one of the beams, probably the date of erection on site. The whole affair was held together by wedges, demolition being easy when these were removed; Mr. Harry Beavis made some excellent drawings of the structure containing the wheel, and of the wheel itself which has been fitted for four horses to be employed.

The Gin House was polygonal having a pan tiled roof and ridges, supported upon stone pillars and timber; there was also a short tie ridge joining the structure to the threshing barn to cover the overhead timber layshaft which was octagonal, the faces being 5 in. wide. It is most likely that the large bevel wheel had inserted wooden teeth to gear with the cast iron pinion on the lay shaft; the large gear driving the threshing machine would also have inserted teeth probably. It is to be erected again at the Beamish Open Air Museum.



A low ratio gear up for slow speeds powered by a single horse, adapted to a chain bucket or rag water wheel for water lifting.



A partly-completed model two-horse coal mine winding gin, being built by G. P. B. Piggins, the well-known Industrial Archaeology lecturer. The vertical shafts (called "starts") had to be capable of swivelling for horses to be turned round to reverse the direction of the winding drum.

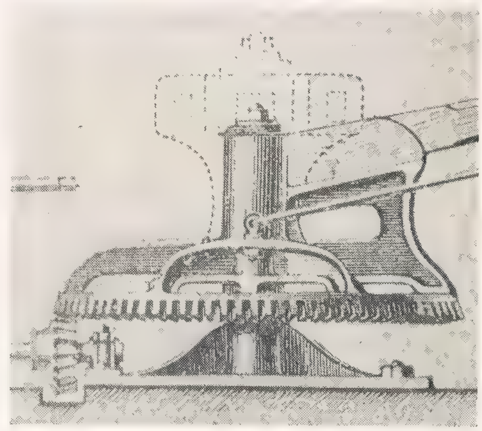
About a century ago, the firm of Case of Racine U.S.A. issued a whole range of horse powered units, one being the inclined tread-mill. (It will be remembered that one of the competitors for the Liverpool and Manchester Railway Prize entered a machine powered in this manner.) Case's other manufactures which went by the name of "Woodbury's" plainly showed their origin stemming from the old built-in horsewheels, but Case's produced these Woodburys to operate in portable form, sweeps being provided for up to 10 horses. The sweeps were attached to a large geared ring which was most ingeniously applied to give a high ratio multiplying gear, suitable for threshing or circular saw work, the machine having to be anchored by peg and ropes. A hand brake was fitted for quick stopping.

In this country a compact form of horse gear was developed: this took the form of a base casting having a vertical spindle around which the large bevel gear and the horse sweeps rotated; the base also carried a bearing for one end of the driven shaft. The base was sunk into the ground to allow the horizontal driven shaft to be below ground level, out of the way of the horse's feet; the shaft was generally run through an iron pipe, which allowed the ground to be made up over it.

Wherever possible, the shallow pit into which the horse gear was sunk was drained, and in some cases the circle the horses travelled was built up higher than the surrounding ground to allow this drainage. Some of these gears could be fitted with a capstan to allow the insertion of capstan bars, so that they could be rotated manually for pumps aboard ship.

Of course many older people can remember the old mortar mills and cider mills where a horse walked round the outside of a trough, metal in the case of the mortar mill, and stone in the case of the cider mill; this was just an adaption from the old horse gins or whims as they were often called.

The lifting of the water in Joseph's well at Cairo was originally accomplished by two stages of horse or mule-powered chains of pots, and it is probable that the original gears were wooden pegs in two wheels at right angles engaging with each other. The principle of lifting water in this manner can be accomplished by the use of a water wheel of the "Rag" type in reverse; in this case the gear up ratio is much less, while where the water lifting is by the "Chain Helice" system the gear up has to be high. Water can be lifted up to 70 feet or more to the surface, provided the speed of the unit is high enough; the higher the lift, the smaller the quantity of water delivered at the surface.



A standard single horse gear having a high gear ratio for threshing, etc. The dotted lines show how the gear is adapted for manual working as a capstan.

To conclude, I would say that unlike the old wooden horse gears, which always were housed, the more modern cast iron horse gears rarely had any protection from the weather, and can be seen sometimes in a clump of nettles beside the barn, the wooden sweep rotted away.

STOLEN MODEL

A $1\frac{1}{2}$ in. scale Burrell g.p. traction engine was stolen from Kew Bridge pumping station between 4 and 7 January. It is painted green with red and black lining. Information as to its whereabouts should be passed to Brentford Police, tel. 01-568 3311, or Tony Cundick, general manager of the Kew Bridge Engines Trust, 01-568 4757.

AN UNUSUAL ENGINE

by A. Howarth

THE WRITER served his time as a fitter and turner in the mid and late 'thirties at a firm engaged in steam engine construction, mainly to the textile and coal-mining industry in North-East Lancashire. The firm was located in Nelson, Lancs., which was, in those days, largely a cotton weaving town.

The engines constructed by this firm were of the cross-compound, tandem and vertical compound type, all condensing, with Edwards type air and extraction pumps and steamed from "Lancashire" boilers at 100-200 p.s.i. usually. The power of these engines was up to 1000 I.H.P. They could power 3000 looms, which was a large weaving shed in those days. I therefore gained a wide experience of prime movers of these designs (including beam engines). During my apprenticeship I attended the local technical college and obtained an O.N.C. in Mechanical Engineering.

On completing my time, I was invited by the Company to join the Drawing Office, which I naturally accepted. On entering the D.O. I was, of course, "the junior" being "the last in". I quickly learned that it was the junior's job to go out to the various mills and "indicate" the engines, both our own manufacture and those of others. I had had some experience of this on the shop floor so I was no stranger to this procedure. The time duly arrived when I was called into the Chief's Office and told that I was to proceed, after lunch, to Messrs. So and So's cotton mill and "indicate" the engines.

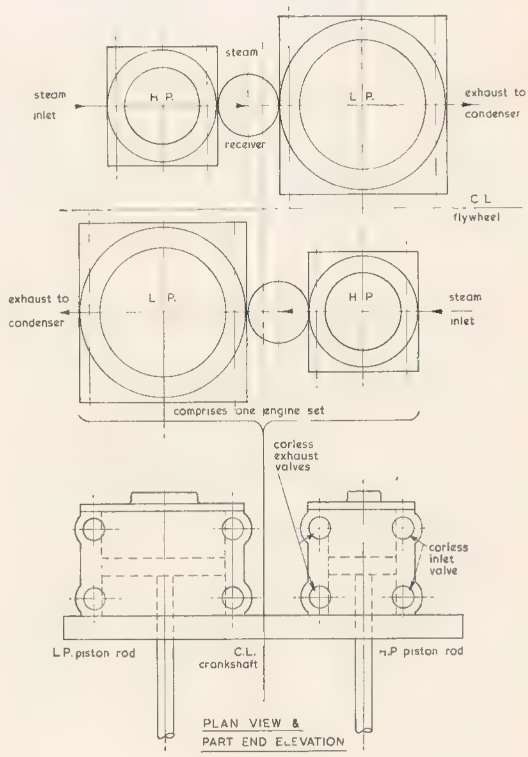
With smug satisfaction, I oiled and checked the indicator and springs etc. in its polished mahogany box and experienced a glow of self-importance. Meanwhile, I asked of my colleagues, "Is she one of ours or a foreigner? Cross compound, tandem?" A dazed look came over their faces. "Dunno mate, never been," was their reply.

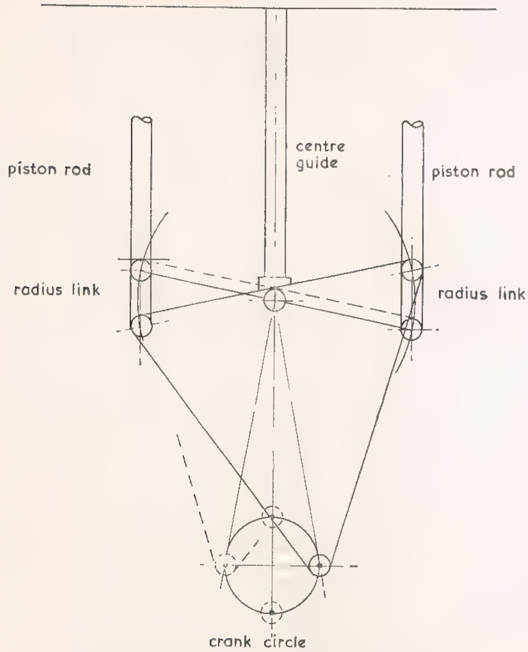
I set off for the mill concerned and eventually reached the general office and announced my arrival, enquiring as to the whereabouts of the engine-house and the name of the engineer-in-charge. I must add that the meal-time breaks of the cotton and engineering industries varied considerably at that time and consequently the engines had not started for the afternoon shift.

I eventually found the engine-room and met the engineer at the door having a "breather". I announced who I was and the job I had come to perform. He immediately took out his pocket-watch, glanced at it and said, "Aye, lad, ah'll be starting her up in a couple o' minutes", in a broad Lancashire dialect.

I followed him into the engine-room, glancing at the pressure gauge on the wall in order to select a suitable spring. My first quick glance at the engine showed it to be a vertical of some type or other, certainly not one of ours, and fairly large. I judged it to be of some 700-800 I.H.P. I walked over to the engine whilst the engineer was oiling round and my jaw dropped in astonishment at the sight. Remember that these were first impressions on a comparatively young chap.

The engine, in fact, was a vertical two-crank compound with the usual rope driving flywheel between the cranks. There, all similarity ended. Looking in plan, there were two high pressure cylinders and two low pressure cylinders arranged in what the motor-cycle industry would call a "square-four". One H.P. cylinder and one L.P. cylinder were coupled to one crank through a triangular connecting rod! If I remember rightly all four cylinders were equipped with the usual Corliss valve gear and exhausting to a jet condenser and "Edwards" type air pump driven from, I think, an eccentric from the crankshaft. Whilst I was gazing in awe at this frightening contraption,





PART ELEVATION ON CONNECTING-ROD

the engineer-in-charge came round to where I was standing and said, "An' how d'ye like my 'kicking mule' then?" I gulped and replied, "A bit unusual, isn't she?" "Aye," he said, "none so many o' these about. Time to start up now lad" and walked over to the stop-valve. He gave the valve handwheel a quick quarter turn. Slowly she began to turn. He gave her more steam, watching the governor gear gradually taking control until she was on speed. "Give her five minutes lad and she'll be on full load", wiping his hands on a piece of the familiar cotton waste. I gazed at the now fully steaming engine in fascination. The rhythmic antics of this triangular connecting rod defied description, as anyone with an idea of motion work will be able to appreciate. As I was watching, I was almost unable to stop dancing in rhythm to its motion. A short conversation with the engineer later revealed that there was only this one ever made.

If I remember rightly, it was constructed by Musgrave. The only reason I can think of for this unusual design is that it was a fairly powerful engine in an extremely small space. Incidentally, I experienced no difficulty in "indicating" the engine.

I have, over the years, become increasingly interested in model engineering and it has occurred to me frequently that this engine would make a fascinating model. I have, therefore, given some thought to its geometry. It will be obvious that the basic geometry will be as in the diagram. That is a H.P. and L.P. piston (comprising one engine) working in the cylinders at the same level throughout the stroke. This would be equivalent to the ends of the piston rods being connected by an imaginary bar with a single conventional connecting rod attached to this imaginary bar at its centre. If this bar is regarded as the base of the triangle then the two hypotenuses will converge at the apex, being the crankpin. It will be seen that only at top and bottom dead centres will the base of this equilateral triangle be horizontal. At other points in the crank circle (corresponding to different points in the stroke) this base line of the triangle will acquire a rocking motion, consequently intermediate links will have to be interposed between the horizontal part (base line) and the piston rod ends (crosshead). This, at any rate, is as I see it and perhaps your readers will correct me if any flaw is seen in this reasoning. After all, it is almost 40 years ago, and memories grow dim. My only regret is that I did not have a camera at the time. What I am perfectly sure of is that this engine did have two triangular connecting rods! And the foregoing is the only way I can see of it being accomplished.

I do intend, in the near future, to construct a model of the "Kicking Mule" and will be preparing in a short time full size (model full size, that is) General Arrangement drawings, probably about $1\frac{1}{8}$ in. dia. H.P., $1\frac{3}{4}$ in. dia. L.P. x 1 in. stroke and with piston valves replacing the Corliss valve gear.

Needless to say, my colleagues on returning to the D.O. said in unison with beaming smiles, "Well, what sort of an engine was it?"

BEARINGS

SIR,—I have only lately had an opportunity to give Ted Martin's thought-provoking article "Railway Reverie" the attention which it merits. Cross-fertilization of ideas —in this case between Mr. Martin's extensive internal combustion engine experience (some of it right here in St. Catharines) and his more recent but obviously equally extensive model live steam experience, cannot fail to advance the art of model engineering, and a judicious spice of his characteristic philosophy is surely also to be commended, when we too rarely stop to think why we are doing what we are doing.

Turning to a specific matter which he raises, the pros and cons of applying ball and roller bearings in a small locomotive are of particular interest. At the present time I have a $\frac{3}{4}$ in. scale *Princess Marina* under construction, and could be persuaded to alter the design—is it in fact worth incorporating anti-friction bearings in the axleboxes of such a locomotive, or are they too susceptible to grit to be worth the extra complication? I recall this topic being touched on but rarely in *M.E.* and would certainly be interested to hear comments from those who have first hand experience.

In fact, since this is my first locomotive larger than HO, I should be interested to hear any comments on the *Princess Marina* design in general.

Ontario. F. G. Wilks

Determining Flatness

by A. Mackintosh

SOMETIMES IN THE SHOP it is necessary to know how flat a piece of material is before beginning work on it. Methods of scraping and flattening a piece of steel or cast iron are well known and have been written up thoroughly in *Model Engineer,* but they require a lot of patience and time and frequently it is not worth the trouble for a small job.

When making an optical flat, generally the testing is done against a master flat in monochromatic light. The requirements for an optical flat are very stringent and deviations from flatness should not be more than a few millionths of an inch at most; requirements in the shop are not likely to be anything like this and we will be quite satisfied if the piece of metal under test is flat to within one hundredth of a millimetre.

The following method is not original but is not widely known; it was sent to me by a correspondent in Italy who tells me that he learnt it from an old workman in an optical shop. It has some similarity to the fringe test for optical flats except that in this case the fringes are replaced by a liquid. All that is necessary is a large prism which need not be precise optically, and some alcohol. I use a surplus tank prism which I bought many years ago after the war when the market was flooded with them; it measures 69 x 49 x 168 mm. If a suitable prism is not available, an optical cube could be used or, in the last resort, a piece of good window glass about half an inch thick and about 1½ in. wide with the long sides ground straight and flat.

The prism is placed on the piece to be tested as indicated in the drawing, attention being paid to cleanliness and that there are no grains of dust between the surfaces; also that the surfaces are well dried.

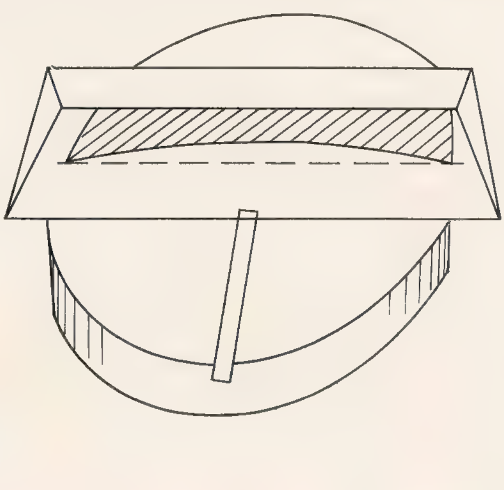
A small piece *cut* from a newspaper or writing paper is inserted in the position shown so that it penetrates under the prism not more than two or three millimetres. The reason that "cut" is italicised is that if the paper is torn, the ragged edges are likely to give a spongy support to the glass.

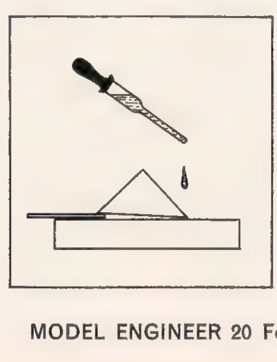
On the side of the prism opposite to the paper where the glass is in contact with the piece under test, drop two or three drops of alcohol from an eye-dropper and wait a few minutes. Capillary action of the alcohol will draw it under the surface of the glass for about 10 mm. The boundary will be a straight line in the case of a flat surface but will be an enormously enlarged curve in the case of a curved surface.

If a bubble of air makes the distribution of the alcohol uneven, lift the edge of the glass on the paper side and work it up and down; if this fails to straighten the alcohol line, rotate the prism a little keeping the alcohol side in contact—a little patience is sometimes necessary.

The shape of the piece under test will be that of the line produced by the alcohol as seen from the side opposite to that of the paper. The case in the drawing indicates that the surface is concave. Sensitivity is high; if the newspaper is 1/10 mm. thick and the width of the prism is 35 mm., each deviation of 1 mm. in the line of the alcohol will indicate 1/350 mm. in the surface under test.

This test is useful, of course, only if the surface under test is non-absorbent. It can be used in preliminary testing of an optical flat, final testing being done with interference fringes in monochromatic light.





MODEL LOCOMOTIVE BUILDING

A Heywood Locomotive

for $3\frac{1}{2}$ in. gauge

Part II

Built and described by B. G. Markham

From page 133

At the time the article in *The Engineer* was written, I do not think *Ella* had an adjustable blast nozzle. However it is known that a long perforated petticoat pipe was used with the adjustable blast nozzle but whether or not the nozzle was inside or below the pipe I have not been able to ascertain.

I do not know whether Sir Arthur invented the controllable blast nozzle or to what extent it has been used on standard gauge railways. A description of an automatic variable blast nozzle is given in *Engineering* of 31 December 1909. The locomotive concerned was designed by Thomas Whitelegg of the London Tilbury and Southend Railway and was built by Robert Stephenson & Co. The control was linked to the reversing gear; the smallest orifice being obtained in mid gear increasing progressively to the maximum in the full gear position. Heywood's nozzle was controlled by a lever mounted on the side of the reversing pedestal.

One photograph shows my blast nozzle complete with the blower ring and exhaust pipes. The other shows the nozzle in position. Since this photograph was taken a bell mouthed petticoat has been fitted. This does not seem to have made much difference when running but has improved the effectiveness of the blower.

A sectional drawing of the blast nozzle and blower ring will be included. The body is made from brass bar 1 in. x $1\frac{3}{4}$ in. x 2 in. The method of machining is as follows:

Mark out; saw roughly to profile; four-jaw chuck, turn and screw $\frac{5}{8}$ x 26 and drill $\frac{3}{8}$ x 1 deep; hold in chucking piece, turn and screw $\frac{1}{4}$ x 40, drill No. 27 or 26 and ream 5/32; mark out; drill 23/64 holes and ream $\frac{3}{8}$; solder to holding piece and mill $\frac{1}{2}$ in. thick.

The blower ring is a standard design. It should be a good fit on the blast nozzle. It is held only by the steam pipe.

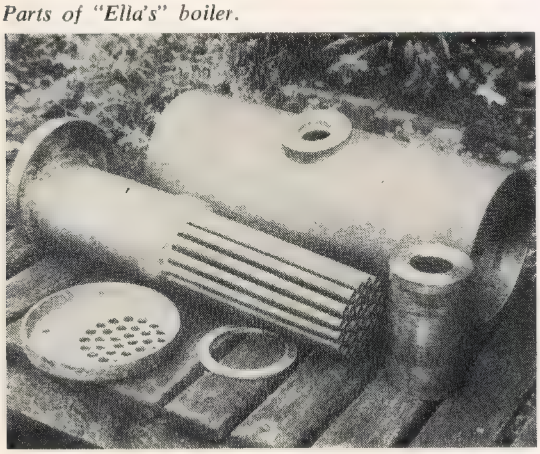
Originally the three blower holes were drilled No. 70, .0276 in. with a $\frac{1}{8}$ in. steam pipe. At lower boiler pressures this was too small and the size was increased to No. 64, .036 and a 5/32 in. pipe was fitted which gives a more than adequate blow at low pressures.

The blast nozzle spindle has a travel of about $\frac{3}{8}$ in. and gives orifice areas equivalent to round holes between about $\frac{1}{4}$ and 11/32 in. dia. The extreme limit when the parallel portion of the "Carrot" enters the $\frac{3}{8}$ in. hole gives an area approximately equal to that of a 13/64 hole.

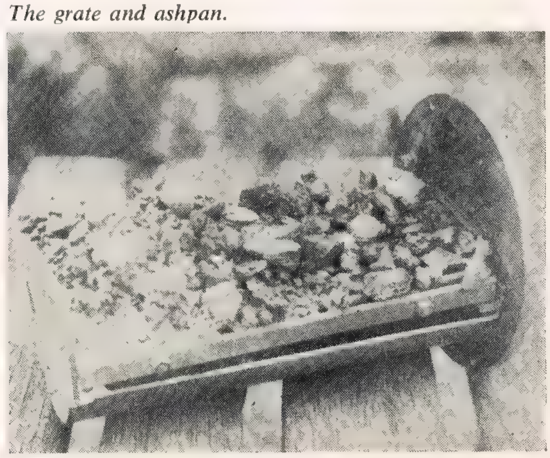
The spindle should be screwed into the "Carrot" with a drop of Loctite using the high temperature grade. The body of the blast nozzle is slipped through the hole in the bottom of the smokebox and the nozzle is then screwed on tight. It will crush the smokebox locally sufficiently to make an airtight joint and be quite firm. Mine lined up correctly with the petticoat pipe, but it should be checked and corrected if necessary.

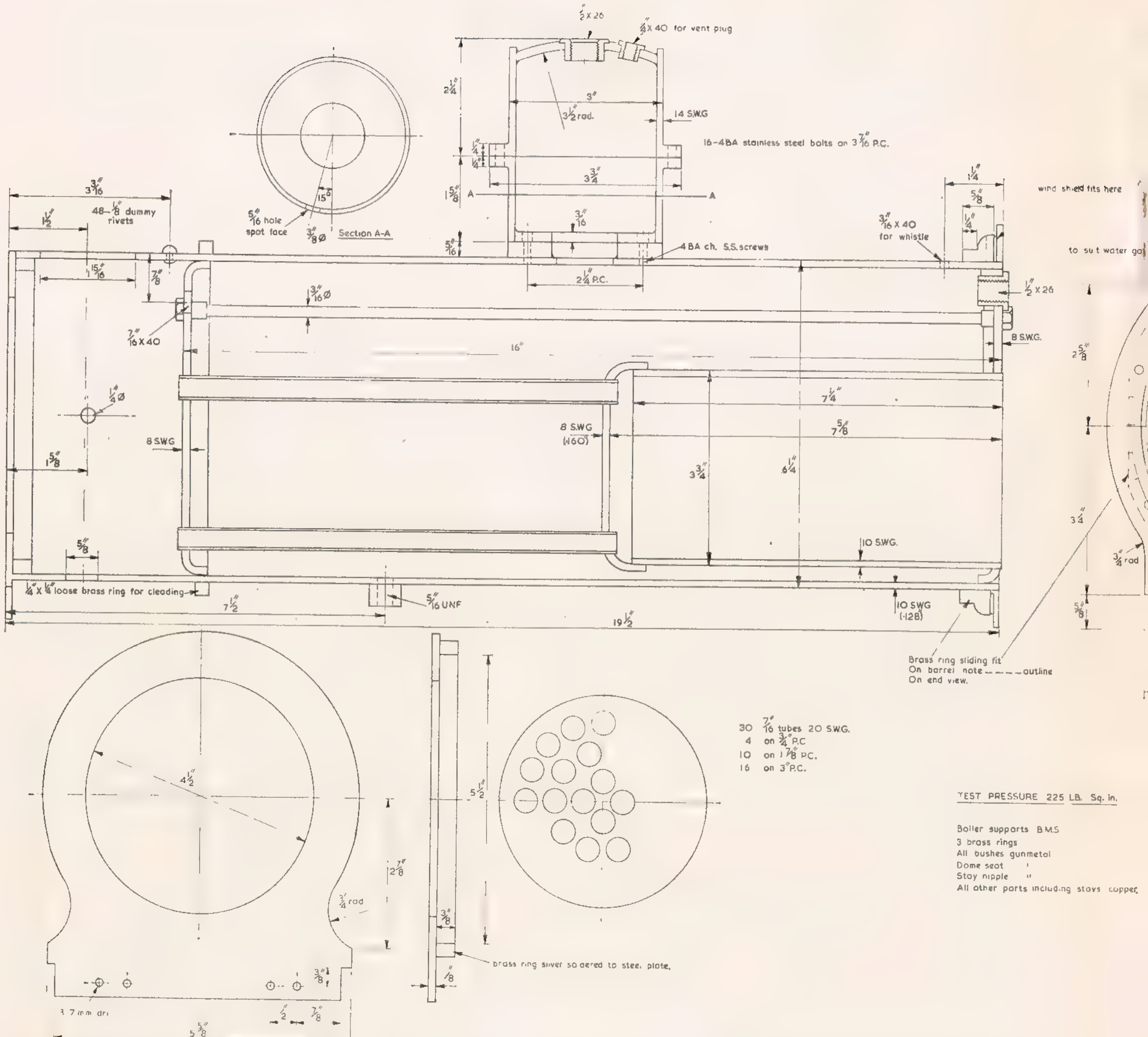
The next item is the smokebox door which really is only called a door by courtesy as it has no hinges and is nothing more than a 3/32 in. or 14 swg plate $4\frac{3}{4}$ in. dia. dished out by about 5/32 in.

Parts of "Ella's" boiler.



The grate and ashpan.





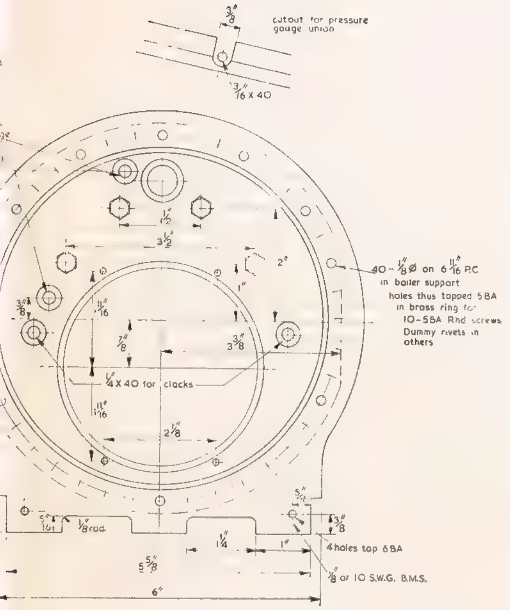
BOILER AND SUPPORTS FOR ELLA

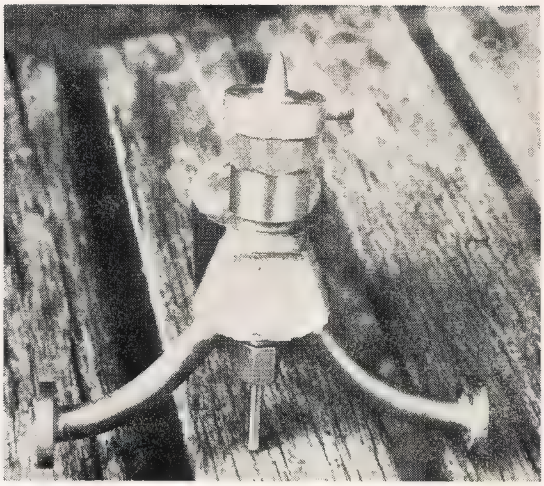
It is held in place by a special 5 BA screw with a big head fitted with a $\frac{1}{8}$ in. dia. tommy bar. The cross bar is a piece of $\frac{1}{2}$ in. x 3/16 in. m.s. $4\frac{7}{8}$ in. long drilled and tapped in the centre 5 BA. That is all it is and I will not take up valuable space with a drawing.

We can now leave the front end of the boiler and move back to the regulator. This is of the slide valve type and I based it on LBSC's *Maisie*. The steam passage is 7/32 in. dia. and the port a single 11/64 in. hole. It has been suggested to me that these steam passages are rather too small and I therefore fitted a steam chest pressure gauge to check the difference between steam chest and boiler pressure at full throttle. The conditions giving the highest pressure drop are full gear and high speed.

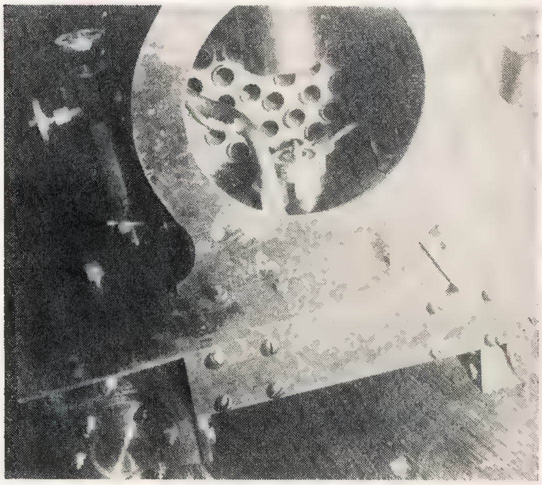
On my short test track there is hardly room to get to full throttle in full gear without wheel slip, but I had a try. Two-thirds of the way down the track I opened the regulator fully; the wheels slipped, cinders rushed up the funnel and the end of the track rushed at me. Reading two pressure gauges under these conditions was a little difficult.

I tried again with the boiler pressure reduced to 60 p.s.i. with slightly less dramatic results and read about 50 p.s.i. on the steam chest gauge, but I wouldn't say this was accurate. A 10 p.s.i. pressure

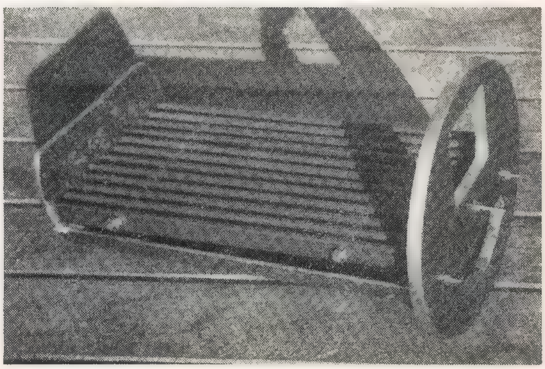




The controllable blast nozzle on the model "Ella".



A view inside the smokebox.



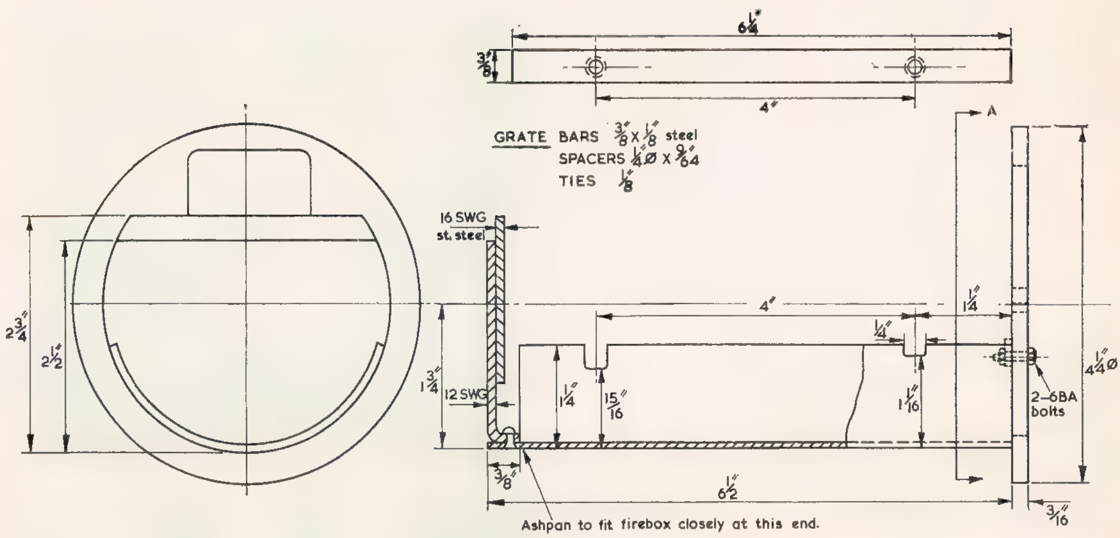
The grate and ashpan.

drop may sound rather a lot but the steam velocity was far above that which would be obtained in normal working. Full gear is 82 per cent cut off and with wheel slip on rather greasy rails the speed was high and represented a quite abnormal condition and a steam flow which *Ella*'s boiler could not maintain. In practice, except at very low speeds when the pressure drop is negligible the engine always runs with the regulator less than fully open.

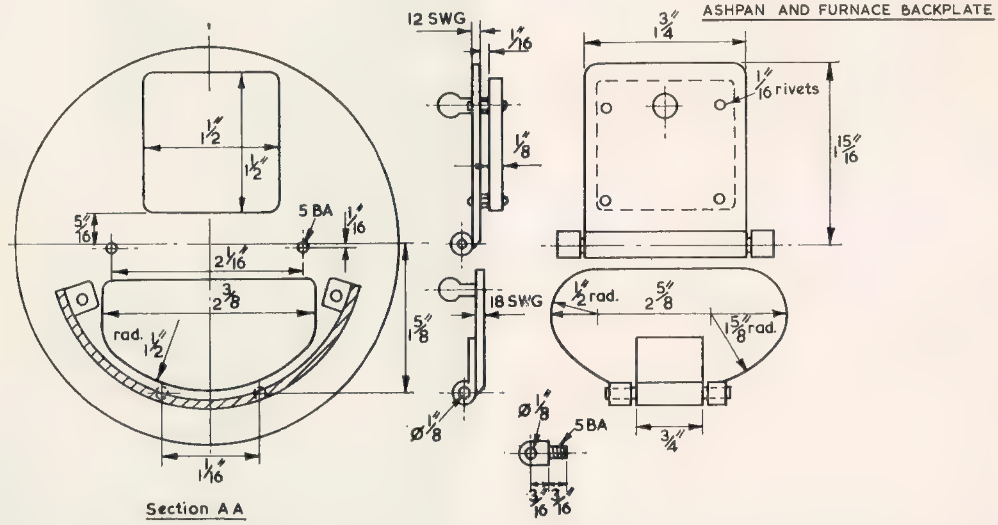
While writing this, it has occurred to me that it would do no harm to increase the size of the port from 11/64 in. round to 11/64 in. square which would give a 27 per cent increase in area or perhaps to 11/64 in. x 3/16 in. which would almost halve the pressure drop across the port.

The regulator works very smoothly and gives excellent control. It is also steam tight. In my experience it is far superior to the disc-in-tube type.

The main body was fabricated from half square 60/40 drawn brass but unless a non-corrosive feed water can be guaranteed it would be better to use



ASHPAN AND FURNACE BACKPLATE



Section AA

drawn gunmetal. The valve could well be phosphor-bronze and the crank plugs and connecting rod either gunmetal or phosphor-bronze. The spindle and screws are all stainless steel and the best stuff to use is 18-8 Austenitic stainless steel which can be identified by the way in which it completely disregards the attention of a magnet. I had difficulty in getting this material in 5/32 in. dia. for the spindle and made do with magnetic so-called stainless, and hereby hangs a tale.

I was running one day and stopped for water and coal. When I tried to restart I opened the regulator and nothing happened and I thought something terrible had occurred. I could see nothing wrong; the cylinders were still there and so was everything else! It was only when I got it up on the bench that I found the regulator stuffing box turned when I moved the lever. When I got the spindle out I found it was mostly bright, but with two or three isolated areas of corrosion, one of which was in the stuffing box. This had caused an incipient seizure such that when the regulator was closed the stuffing box unscrewed, but for some reason when the regulator was opened it did not screw up again. In other words it was working like a ratchet and it had unscrewed the stuffing box far enough to disengage the square end of the spindle with the crank.

I have recounted this experience because with some designs it may be possible for the stuffing box to come completely unscrewed which would have very unpleasant consequences. To avoid the risk of further trouble I have fitted a 10 BA locking screw.

To be continued

MODEL LOCOMOTIVE CONSTRUCTION FOR BEGINNERS

Part XIII

by Martin Evans

From page 138

Stephenson Link Valve Gear

CONTINUING with our examination of the Stephenson link valve gear with launch-type links, I should perhaps mention that the true launch link has the point of suspension on the curved centre-line of the link slot but beyond one end of the slot, but in the launch-type link, the suspension is arranged on the horizontal centre-line of the motion.

G. J. Churchward was the first engineer to realise the great possibilities of the launch-type link for locomotive work, and he adapted it for use with large laps and long valve travels. Some other engineers had tried the launch-type link before Churchward, notably Alexander Allan of the L.N.W.R., but none had developed it to the efficiency achieved by Churchward.

Churchward used the launch-type link with comparatively short eccentric rods, so that there was a considerable increase of lead as the gear was "linked up". He therefore arranged for the valves to be set with "negative lead" in full gear, i.e. the valve did not open to steam until the piston had passed dead centre. This negative lead has often confused model engineers, but it should be understood that the negative lead in itself was not necessarily desired, but if the valves had been set "line-for-line", with the short eccentric rods, there would have been excessive lead when the engine was notched up for fast running.

It might be thought that this negative lead in full gear would have made the locomotive sluggish in starting, but this was certainly not the case with Great Western locomotives, as the two-cylinder "Saints", "Halls", "Granges", "Manors" and the tank engines fitted with this type of valve gear were all excellent starters, though it must be remembered that as soon as the driver had his train well under way, he would start to "notch up" his reversing gear, so that the negative lead would quickly change to a positive one.

Designing launch-type gear

Great credit is due to the late G. S. Willoughby, who in a series of articles in *Model Engineer* in 1937, dealt with this gear in great detail and made the designing of it for models from ½ in. scale upwards simplicity itself.

As with all valve gears, the first thing to be decided is the full gear cut-off required. In full-size practice, the full gear cut-off would be decided according to the work the locomotive would be required to perform. A two-cylinder Contractor's type of engine would probably have a F.G. cut-off of 85 per cent, a main-line shunting or goods locomotive 80 to 85 per cent, and an express locomotive 70 to 75 per cent. Three- or four-cylinder express engines might have even less than 70 per cent.

In the case of model locomotives which may be used equally on a short up-and-down line or on a fast continuous track, it is advisable to make the cut-off fairly late. While it is true that at late cut-offs, the angle of the connecting rod in relation to the main crank is very small, it may be taken that anything up to 85 per cent cut-off is useful for starting a two-cylinder locomotive. In any case, providing that the mechanical layout allows for it, and that there is sufficient clearance for the various parts of the valve gear, there are no disadvantages attending the use of a late cut-off in full gear. There are however two distinct advantages: one is that a late cut-off gives a full steam port opening early in the stroke; the other is that an engine so arranged has a more even turning movement at slow speeds, so that the tendency to slip at starting is reduced.

To obtain a full gear cut-off of 80 per cent of the stroke, the full gear valve travel should be made 4½ times the lap of the valve; for 85 per cent, the F.G. travel should be 5 times the lap. This ignores any lead that might be given to the valve, but with launch-type links and short eccentric rods (by "short" rods is meant a scale equivalent of less than 4 ft. 6 in.) the valves should have no lead at all in full gear, but should be set line-for-line with the cranks on dead centre.

With locomotive-type links and medium-to-long eccentric rods, a small amount of lead in full gear may be provided, and this would make the cut-off earlier.

To obtain success with Stephenson gear with launch-type links, the various parts must be carefully proportioned, and the following rules, evolved by Mr. Willoughby, will be found to give excellent results. I have used them myself on all my designs with this type of valve gear.

Proportions of Stephenson valve gear

1. Throw of eccentrics for launch-type links = ½ full gear valve travel.
2. Thickness of eccentric straps to be between 1/5

and $\frac{1}{6}$ of piston diameter to the nearest round figure.

3. Motion pins to be approximately $\frac{1}{8}$ of piston diameter.
4. Boss diameters on links, eccentric rods and valve rods to be twice pin diameter.
5. Width of curved slot of expansion link = pin diameter $\times 1\frac{3}{4}$.
6. Thickness of expansion link to be between 1/5 and 1/7 of piston diameter, according to space available.
7. Distance between eccentric rod pins to be full gear valve travel $\times$ 2 for short eccentric rods, or $\times 2\frac{1}{8}$ for long rods.
8. Length of curved slot in expansion link to be eccentric rod pin centres $\times 1\frac{5}{8}$.
9. Length of die-block to be motion pin diameter $\times 2\frac{1}{8}$, to nearest round figure.

I have found in practice that in No. 8 above, the length of the curved slot need not be quite so great. The important thing is that the die-block must not foul the ends of the slot in either full forward or full backward gear. The figure given allows ample clearance for every likely example.

Suspension of the link

The point of suspension of the expansion link in Stephenson gear makes a great deal of difference to the valve events obtained. On some models (and I believe on some full-size engines) the lifting link is attached to one of the eccentric rod pins, usually the one furthest from the weighshaft, but this is bad practice and is only done to avoid the extra work involved in making a proper central suspension; it can only lead to unequal valve events.

I have already mentioned the importance of the locomotive being fitted up so that the eccentric rods are in the "open" position. To ensure this, with the slide valve engine fitted with direct drive to the valves, the right-hand valve gear should be drawn out to as large a scale as possible and with the crankpin at the back dead centre position. Then the outside eccentric rod nearest to the right-hand frame is the forward one and is connected to the top boss of the expansion link. The inside eccentric rod will be the backward one and is connected to the bottom boss of the link. In this position, the forward eccentric will be "up", and the backward eccentric "down", and the expansion link will stand exactly vertical, or at least at 90 deg. to the horizontal centre-line of the motion.

At this point, I would make a slight departure from the instructions given by Mr. Willoughby. He says that with the valve gear set as described above, the lifting link should also be exactly vertical. But I think this is incorrect, for in this position, the die-block has been moved forward from its central position by an amount equal to the lap of the valves, so the lifting link will be inclined slightly forward, as seen in the lower drawing on page 137 (6 February).

To arrive at the best possible position for the suspension of the expansion link by the lifting link where long valve travels are required, it is necessary to consider what errors, caused by the obliquity of the link when inclined forward or backward, have to be neutralised. With the launch-type link, there are two main kinds of "link-slip", therefore the point of suspension of the link must be chosen such that each of these two kinds of link-slip is not decreased at the expense of an increase in the other.

By suspending the expansion link on its horizontal centre-line, certain advantages are gained. The suspension point is never very far away from the die-block in any position of the gear, so that the lifting link always has a good leverage to hold the link with the minimum of link-slip. Secondly, the steam distribution improves, and link-slip decreases, as the valve gear is "notched up" towards mid gear, as this brings the suspension centre still closer to the die-block. Also, as the suspension centre is midway along the link, the steam distribution will be equally good in either forward or backward gear.

Another advantage of suspending the link on its horizontal centre-line is that the swing of the lifting link is very small; this reduces wear, but more important, it means that there is very little swinging effect transmitted from the lifting link to the expansion link itself, which would otherwise tend to move the link vertically up and down on the die-block.

The next task is to decide the exact point on the horizontal centre-line to locate the pin for the lifting link. If the expansion link is suspended at the point where the horizontal centre-line cuts the curved centre-line of the link slot, this would allow of rather too much link-slip as this point of suspension is too far forward from the points where the expansion link is driven, i.e. the eccentric rod pins. The eccentric rods have less control over the action of the link at the position where the die-block is located, and thus allow the link to rise and fall upon the die-block to some extent, making the cut-off earlier at one end of the cylinder than at the other.

If the expansion link is suspended at the point where a line drawn between the two eccentric rod pins crosses the horizontal centre-line, it is found that the lifting link does not swing so much during the movement of the expansion link as it is now pivoted on a neutral centre. However, it is also found that the rocking action of the eccentric rods is now transmitted to the expansion link in a more marked degree, thus introducing a more severe link-slip, the expansion link sliding up and down

the die-block to some extent, giving a faulty steam distribution.

It will now be clear that the best position for the attachment of the lifting link should lie between these two positions and rather nearer the former. The ideal position will depend on the proportional length of the eccentric rods. With short eccentric rods, the second or more virulent error is likely, and therefore the point of suspension may be slightly further forward, i.e. nearer to the curved centre-line of the link slot. If a line is drawn between the centres of the two die-block positions in full forward and backward gear respectively, this may be taken as the most *forward* position advisable, while for eccentric rods equivalent to a scale length of 5 ft. or over, the most *backward* position advisable may be taken as the point where the horizontal centre-line cuts the rear edge of the curved slot in the link.

When space permits, two lifting links may be used, one on each side of the expansion link, and suitable brackets should be riveted to the link to carry them, with the necessary clearance for the valve rod fork to embrace the die-block. However, on Great Western engines, only a single lifting link was used, and in spite of the several "offsets" in the gear, no adverse effects seemed to arise, so that a similar arrangement should be quite satisfactory for models.

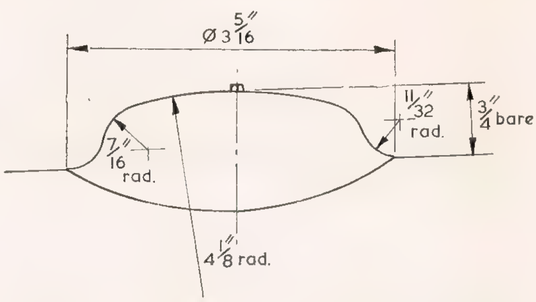
It is most important in Stephenson valve gear that all four eccentric rods are made exactly the same length, so some form of jig should be made up. This might consist of a length of flat steel bar of convenient dimensions on which is set out the overall length of the eccentric rods as accurately as possible. A silver-steel pin is then pressed in at one end, this pin being a close fit in the eccentric rod forks. At the other end, a circular disc, which may be in mild steel, is turned to exactly the same diameter as the eccentric sheaves, and is fitted to the jig. When each complete eccentric rod and strap will fit on such a jig, they will be to the same overall length to quite fine limits.

The lifting arms, which are attached to the weighshaft, must be arranged exactly parallel to each other and in the mid gear position should be parallel to the longitudinal centre-line of the motion. The reversing arm, which is connected to the cab reversing gear by the reach rod, is often arranged at right-angles to the lifting arms, but it need not be so.

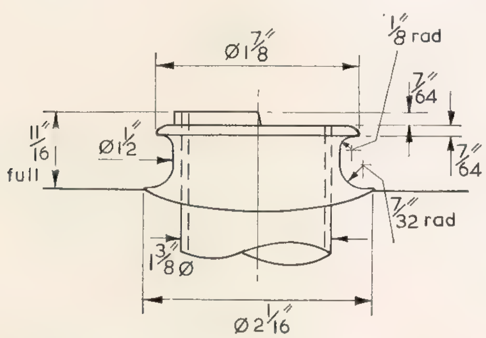
To be continued

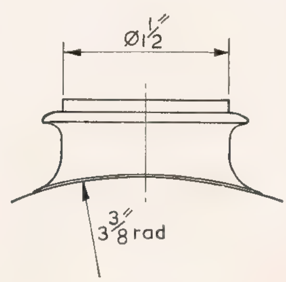
BOILER MOUNTINGS
for
"FURY", "ROYAL ENGINEER"
and
"REBUILT ROYAL SCOT"

Several builders of *Fury* and *Royal Engineer* have reminded me that no detail drawings have yet been published of the chimneys and domes for these locomotives, so I hope that the accompanying drawings will fill the bill. I have also included drawings of the chimney and dome for the "Rebuilt Scot", reproduced from official drawings.

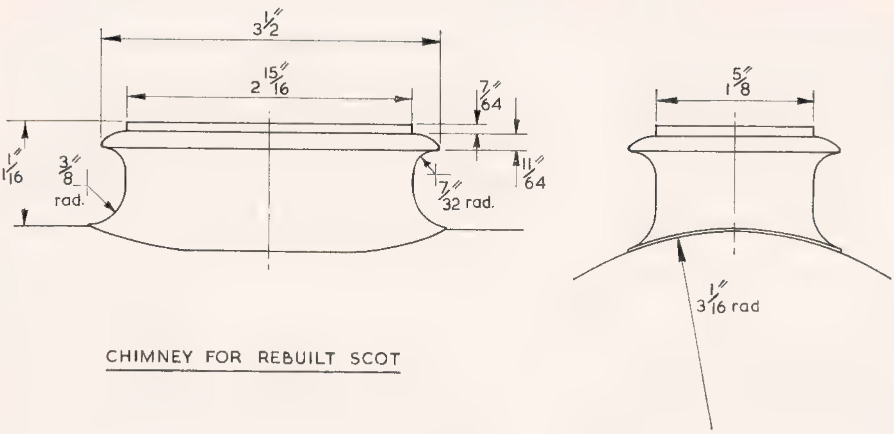


DOME FOR REBUILT SCOT

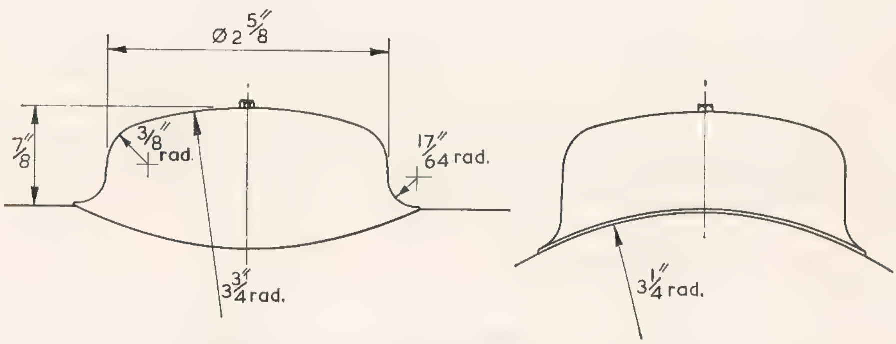




CHIMNEY FOR FURY & ROYAL ENGINEER



CHIMNEY FOR REBUILT SCOT



DOME FOR ROYAL ENGINEER

SMOKE RINGS

From page 163

stability for the driver's and passengers' cars, thus even the small garden up-and-down line must have at least one additional rail. Having laid the extra rail, there is at once the temptation to build a locomotive to run on the larger gauge.

Secondly, most regular drivers would agree that the narrow cabs of the 2½ in. gaugers make driving and firing difficult.

Thirdly, except in the case of the largest prototypes, the 2½ in. gauge boiler is much more difficult to control, water gauges have to be watched much more closely, and the margin between the correct water level and the danger level of a dry firebox crown is much smaller.

Fourthly, the building of the older type locomotives is considerably more difficult in this gauge than in 3½ in. or 5 in. This applies particularly to those engines with inside cylinders and Stephenson link valve gear, involving four eccentrics as well as the crank-axle, all between the frames.

The argument that 2½ in. gaugers are cheaper to build does of course apply if one compares like with like. But a 3½ in. gauge *Tich* is much cheaper to build than a 2½ in. gauge 4-cylinder "Pacific", and a 5 in. gauge 0-6-0 tank such as *Pansy, Speedy* or *Simplex* only very slightly dearer, and certainly superior in performance.

As far as locomotive constructional articles in *Model Engineer* are concerned, Don Young recently described a 2½ in. gauge "King Arthur", but with due respect to Don, I do not think that many examples have been, or are being built, certainly nothing like so many as his 3½ in. gauge "Railmotors".

RECENT M.E. DRAWINGS

LO.944 Boiler for 5 in. gauge "Rebuilt Royal Scot" class locomotive, using "Royal Engineer" chassis. Price 85p inc. VAT.

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A UNIQUE ANTIQUE

The Holtzapffel Ornamental Turning Lathe

by E. E. Hadden-Deering

THE EQUIPMENT to be described was in vogue, for those who could afford it, from about the middle of the last century to the early years of 1900. The activity was described by John Jacob Holtzapffel as "Turning and Mechanical Manipulation on the Lathe and the various mechanical pursuits followed by amateurs".

The unusual feature regarding this machine lies in the fact that quite obviously the lathe and accessories have not been used to any great extent. It must surely be unique that all this equipment should remain in almost mint condition for almost three-quarters of a century. Many tell-tale indications will show if, for instance, a slide-rest has been in action or moved frequently along the lathe bed. These indications are happily conspicuous by their absence.

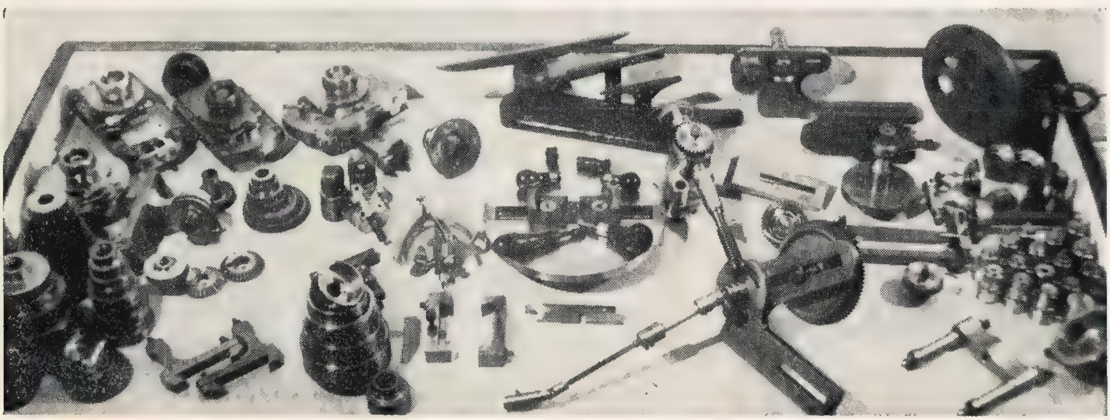
When this machine was purchased at an auction at Maesmynan Hall, near Denbigh, the original Bill of Sale was available. The buyer was unaware of the real nature of his find and indeed had never even heard of Holtzapffel or Ornamental Turning and unfortunately threw the bill away. He remembered the name on the Bill of Sale when he in turn advertised it for sale in the local newspaper.

The equipment is elaborately designed and beautifully made; bronze and steel play a major part in the manufacture. The bed, headstock and tailstock are of course of cast-iron. It would be interesting to know the original cost of all this equipment. The only indication I have ever come across so far is an advertisement in Vol. 3 of the *M.E.* dated September 1900 and stating that the original price was £600. This figure related to today's values would seriously limit the popularity of this hobby!

Since this acquisition I have also secured Vols. I to V inclusive of Holtzapffel's "Turning and Mechanical Manipulation". It is apparent that many members of the nobility and gentry owned these machines and received instruction from this worthy exponent of the art. Holtzapffel devised many intricate accessories and improvements which he has described in his books and fitted to the machines of his clients to whom he refers with great deference. He mentions such names as the Earl of Crawford and Balcares, L. V. Lloyd, Esq., Sir George Pechall, Bart., The Hon. Wilfred Brougham, The Earl of Sefton, Rev. C. C. Ellison, etc. in the preface of his books. One can imagine the noble legs treadling away merrily in those far-off days of no "telly", movies or easy transport.

The purpose of all this elaborate equipment, to quote Holtzapffel, is "the decoration of surfaces and circular axial solids to which the work has first been reduced by plain turning and the production of numerous compound solids and the subsequent ornamentation of their component superficies". The latter process is accomplished by indexing the work through the division plate and other dividing apparatus and applying a revolving cutting tool to its edge or surface.

A selection of Holtzapffel accessories.

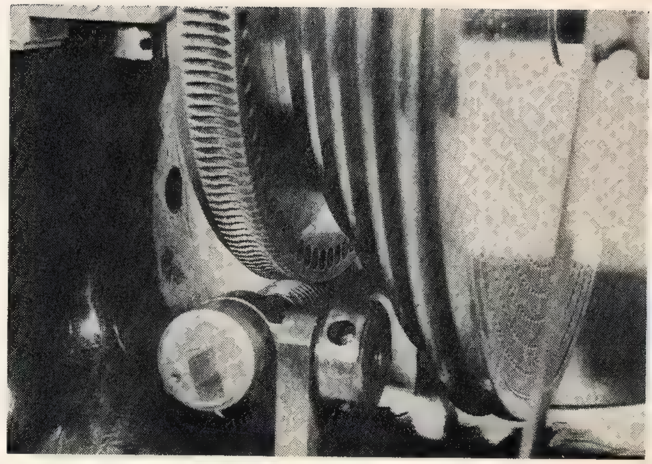


If, for instance, an identical pair of ornamented vases were required, the main body would first be machined to the desired shape using the lathe in the normal manner. To ensure accurate duplication of outline the operator employed a feature called the "Curvilinear Attachment" which required a template mounted on the slide-rest. This apparatus will be described later. For the plain turning the work would initially be held in one of the many different concentric chucks mounted on the mandrel nose and possibly supported by the back centre.

After the body of the vase has been shaped, the work of ornamenting can be tackled. This is accomplished by applying various shaped cutters, revolving at high speed, to the surface of the vase. There are cutters for Beading, Moulding, Right and Left Angles, Quarter Hollows, Double Quarter Hollows, Astragals, Pearls, etc., etc. The vase, still held in its chuck on the mandrel nose, is now under the control of the "Segment Apparatus". This consists of a large 180-tooth bronze worm-wheel integral with the 5 step driving pulley. A single-start worm can be locked into engagement with this for the purpose of slowly revolving the work to locate it at evenly-spaced intervals opposite the cutting tool. More complex patterns can be achieved with the work mounted on one of several large adjustable chucks available: the Rectilinear Chuck, Dome Chuck, Oval Chuck, Eccentric Chuck and others. All these chucks are equipped with a further copy of the mandrel nose-screw which can be located centrally in line with the lathe axis or moved, under lead-screw control, considerably off centre. The work, still held in the original concentric chuck, is screwed to this nose. Furthermore in the construction of each chuck this nose screw is integral with a robust worm wheel capable of rotating the nose and any attachments a full 360 degrees independent of the main chuck. An infinite variety of movement enabling complex geometric patterns is thus possible.

It might be added that most of these chucks are very heavy. The weight of the chuck and workpiece is often very unevenly distributed but the Segment Apparatus holds the assembly rigidly in position. This is of course vitally important as any looseness would reflect on the quality of the finish produced by the high-speed cutter.

As can be imagined, every setting of the Segment Apparatus, chuck-nose and slide-rest must be meticulously charted also every size and shape of cutter identical. A mistake could mean disaster to the work and ruin many hours of work and material. Usually the work was carried out in Ivory, Ebony, Lignum Vitae or some other exotic and expensive hardwood. It could be a nerve-

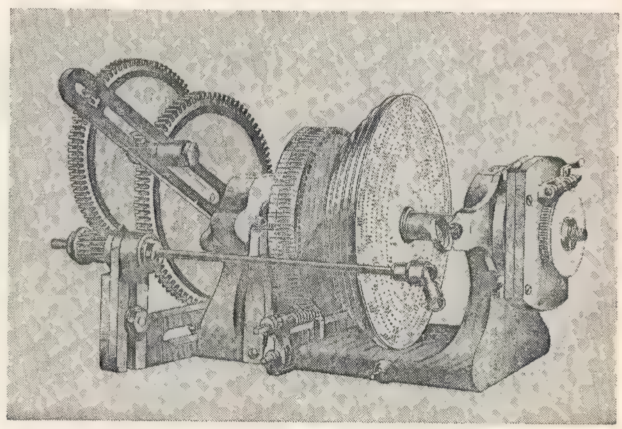


A close-up of the segment apparatus.

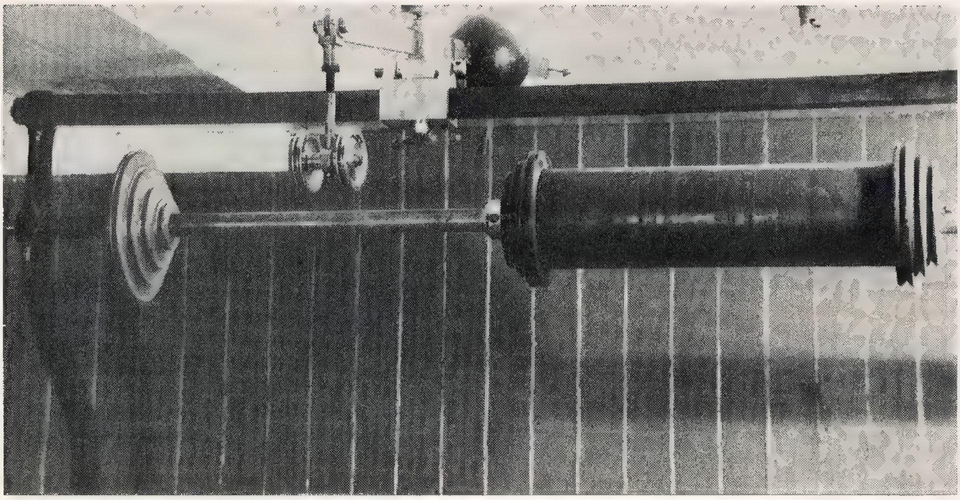
racking activity and I have no intention of pursuing it. In writing this article no claim is made for any skill or expertise in Ornamental Turning. Any knowledge has been gained from a reasonably intelligent study of Holtzapffel Vols. I to V and a little playing about with the equipment available. The purpose of the notes is to provide a brief and, hopefully, interesting description of an unusual hobby and the equipment necessary to follow it.

Very little use has so far been made of the equipment. A six-start worm was made to suit an existing worm-wheel for a dividing gear. To accomplish this a telescopic drive-shaft was manufactured with universal joints connecting the gear train with the slide-rest. A silver-steel cutter revolving at high speed in a Potts Universal Milling Attachment mounted on the top-slide was used to cut the threads. Also a large cast-iron flywheel for a Beam Engine was machined as the diameter was too much for my 4½ in. lathe. At present the barrel of a model Naval Quick-firing Gun is between centres. In addition an adaptor was made

The headstock with an oval chuck fitted.



The overhead gear.



to enable any of the bronze change-wheels to be mounted on the mandrel tail. A 40-tooth wheel with a permanent mounting for this purpose was the only gear available, which rather restricted gear trains.

The bronze change-wheels have gear tooth intervals in multiples of 4. Nos. 24 to 80 with a few duplications. There is a second set of six gears having finer teeth for use with the Spiral Apparatus, also some bevel gears to enable Surface Spirals to be generated.

Treadling a $5\frac{1}{2}$ in. lathe puts rather a damper on one's enthusiasm, so a suitable countershaft unit was made driven by a $\frac{1}{3}$ h.p. motor. In addition, all the high-speed cutter spindles will be driven by a separate motor. Of course the full treadle and overhead assemblies are retained to ensure completeness of the equipment in its original form. As there was a spare bronze backplate available, a 4 in. three-jaw chuck is now in use.

The bench is sturdily constructed in mahogany. It stands 3 ft. high and is 4 ft. 5 in. wide by 2 ft. 3 in. deep. The end supports are of 6 in. by 3 in. section joined by a rear frame of crossed members. The lathe bed is slotted into the front members. There is a mahogany top with a 3 in. rail back and sides. These sections are secured by large steel bolts with turned disc type heads having twin holes for a pin spanner rather than hexagon heads. The bolt heads rest in recesses turned in big nicely shaped bronze washers. The assembled bench looks very handsome. Carved into one support is the name of H. W. DAVIES. MAESMYNEN. It is my guess that these lathes were provided when delivered with a plan of this stand to be constructed locally.

The treadle assembly

This comprises a metal framework supporting the wooden footboard. The frame is pivoted on two pointed bolts through the rear uprights and has two metal hooks to engage the double crankshaft which also revolves on pointed bolts. The flywheel is a massive affair having five grooves for round belts.

The overhead gear

This consists of two nicely shaped cast-iron standards of tapered oval section attached to the bench just behind each end of the lathe bed and connected at the top by a 1 in. square bar. Just below this bar is a free running shaft on hardened steel pointed bolts which are adjustable for end play. A bronze 5-step pulley on the shaft is driven by a long round belt to the flywheel. A cylinder of mahogany $4\frac{1}{2}$ in. dia. and 14 in. long is secured to the shaft through two bronze end discs. The square tie-bar supports a box-like frame of bronze which can be moved to any position on the bar and locked there. Through this box passes a flat bar of steel having a yoke with two jockey pulleys in front and an adjustable counterweight on the other end. The belt for the revolving cutters passes round the mahogany drum, over the jockey pulleys on to the pulley of the cutter frame, thus maintaining even belt tension under all conditions.

The lathe

The machine is a 5.5 in. centre lathe with a hardened steel mandrel which has a traversing feature for use with the Thread Chasing Attachment. The mandrel supports the driving pulley which is of bronze and assembled in two parts. The body is turned all over, inside and outside. The other side of the 5-step pulley is cleaned out for perfect balance and the rim is recessed about 3/16 in. and undercut 4 deg. A bronze disc is shrunk into this recess. After accurately facing, this disc is drilled for 8 rows of division holes: 360, 192, 144, 120, 112, 96, 84, 12. The zero starting

hole in each row is on an arc described from the centre of the index peg to facilitate moving the index pointer from one set of holes to any other set without re-setting. There is scope for adjusting the height of the pointer from the base.

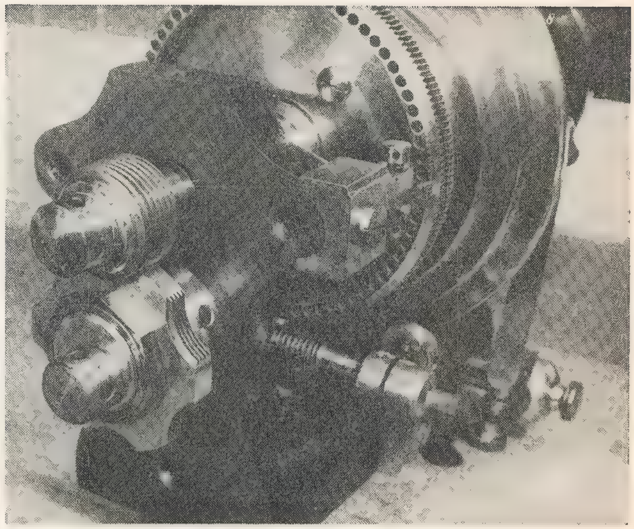
Attached to the driving pulley is the Segment Apparatus which has already been described. The wormwheel, in addition to having 180 teeth, has a graduated chamfered rim with which is aligned a polished steel cursor. It also has a row of reamed holes to accept large-headed steel pegs which act as limits against adjustable steel capstans.

The slide-rest

The massive compound slide-rest is capable of all necessary movements, traversing, cross sliding, vernier raising and lowering for precise tool height, and graduated to swivel to almost any angle. The top-slide is a solid block of bronze sliding on two opposed Vs under the control of a graduated lead screw. It is deeply channelled to receive the special tool-holder for fixed tools and also to accommodate the square shank of the several cutting instruments, the Vertical Cutter, the Eccentric Cutter and the Horizontal Cutter. A wormwheel on the end of the lead-screw driven by the overhead gear provides a slow feed to the slide-rest. Limit stops which are adjustable enable the slide-rest to be reset to any angle. The illustration shows most of these features.

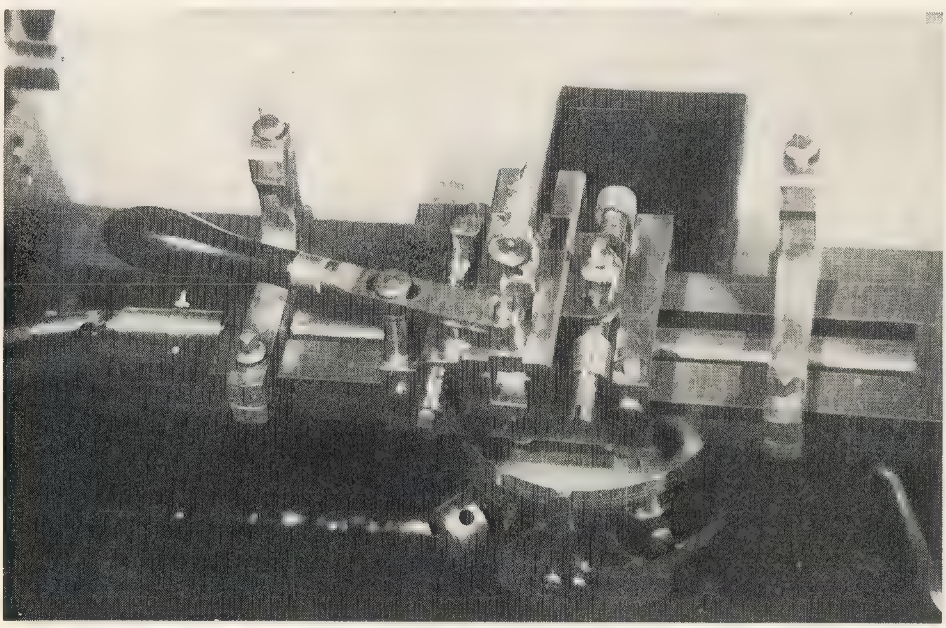
The curvilinear attachment

The picture of the slide-rest gives a good idea of this attachment. Two bronze supports are clamped each end of the bottom slide. Between these is mounted a flat steel bar with numerous threaded holes to secure templates of the outline required. (Not shown in illustration.)

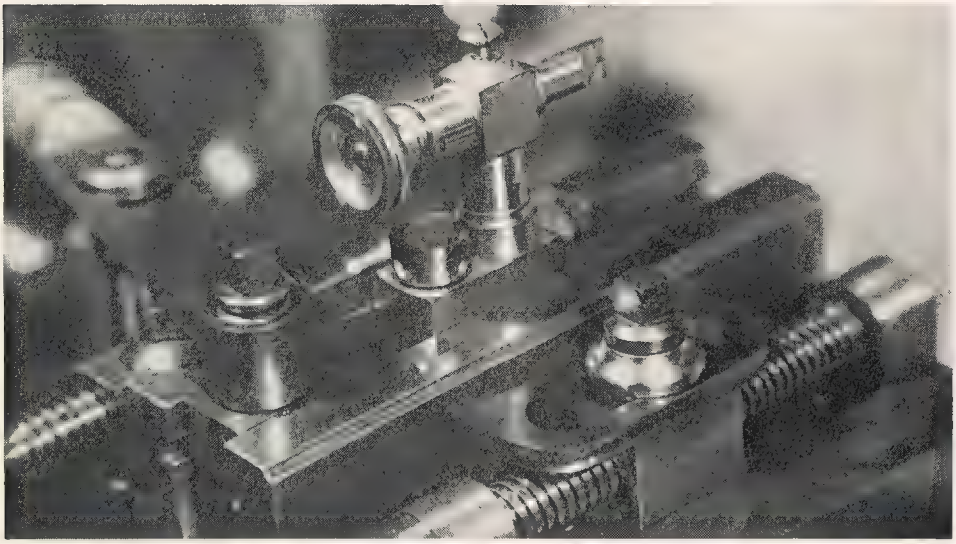


The thread chasing attachment.

A bronze capstan having an adjustable steel rubber is mounted in grooves on the top-slide in line with the template. A half turn of the right-hand lock screw disengages the top-slide from its lead-screw leaving the top-slide under the control of the hand lever which is fulcrumed on the lower part of the slide. With the slide-rest traversing automatically, the hand lever is used to hold the steel rubber against the template thus accurately repeating the outline. The entire apparatus can be set up very quickly.



The slide rest with the curvilinear attachment. The two pillars are to support a flat bar having threaded holes to mount templates.

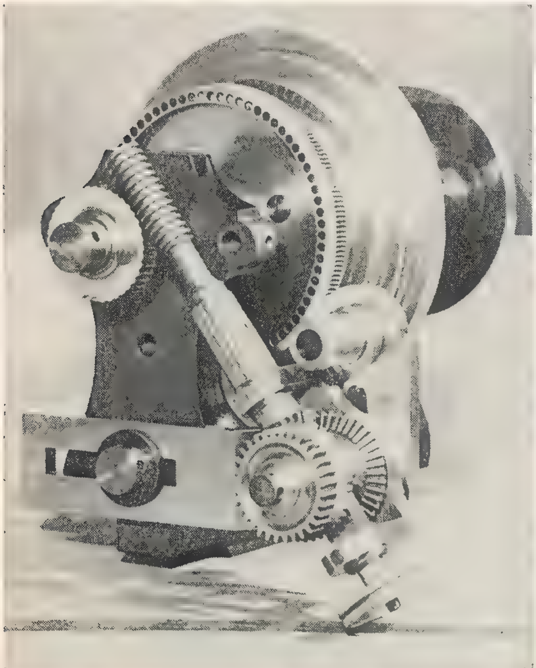


The capstan used in conjunction with the curvilinear attachment. The wedge-shaped follower is held in contact with the template by the hand lever.

The spiral apparatus

This equipment permits threads of over 50 turns per inch or a spiral of only one turn in 7 inches. Both cylindrical and surface spirals can be created and ornamented. An operating handle on the square end of the lead-screw moves the top-slide slowly along the lower slide. The opposite end of the lead-screw is connected to a gear train which revolves the mandrel with work to be spiralled held in a chuck. A cutter revolving at high speed mounted on the top-slide cuts the spiral. By setting the slide-rest at right-angles to the lathe bed and attaching another bracket to the bed coupled to the lead-screw by bevel gears surface spirals can be generated.

The spiral apparatus, showing the reversing bevels.



Chucks

Work can be held in quite a variety of chucks, some of which can move the work to either side of centre and also revolve it independently of the mandrel turning.

The eccentric chuck

The slide of this chuck is provided with a copy of the mandrel nose-screw machined integrally with a large diameter fully graduated wormwheel which can be turned a full 360 deg. for presenting different facets of the work to the tool. The worm controlling this can be quickly disengaged to permit the work to be turned rapidly to any position and then locked. The slide of this chuck can be moved by lead-screw up to 2 in. to one side of centre or can be located with the nose-screw on dead centre by a taper pin. The eccentric chuck is employed for all the surface ornamentation that may be produced with the eccentric cutting frame.

The oval chuck

As with the eccentric chuck the slide has a worm controlled copy of the mandrel nose. The slide can move freely as there is no lead-screw. A large bronze assembly registers over a turned shoulder on the front face of the headstock and is bolted in this position. The assembly has a screw controlled slide on which is machined a large diameter ring precisely concentric with the mandrel axis. The chuck slide is equipped with two parallel steel bars which engage the large ring on the assembly bolted to the headstock. The slide can be moved by its screw up to 2 in. off centre. When the mandrel is

revolved the chuck slide reciprocates back and forth, thereby reflecting the offset of the ring as an oval on the work.

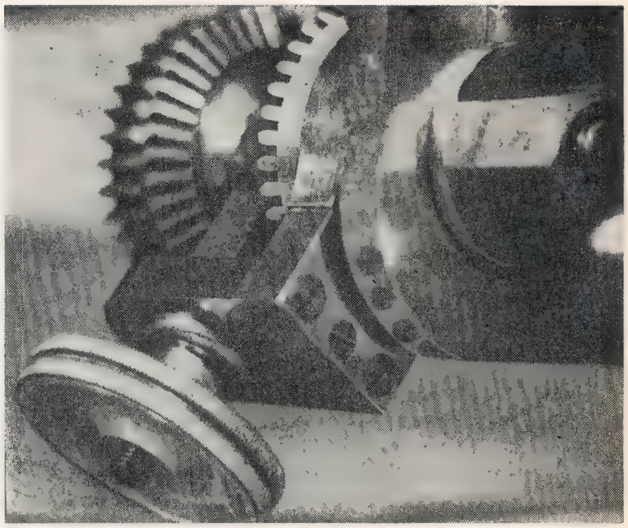
The dome chuck or spherical chuck

This is used for the production of many different shapes such as square or polygonal bases, pedestals, etc., each separate face of which can be further ornamented. It differs from the other chucks considerably. It holds the work at right-angles to the mandrel nose and unlike other chucks it is seldom required to make a complete revolution, its partial movement being controlled by hand or the segment apparatus. Another well-known manufacturer of this equipment, J. H. Evans, states that it can be mounted on the ellipse chuck and even suggests that the eccentric chuck can be interposed between them. The mind boggles at the variations this gang of chucks would make possible.

The rectilinear chuck

This may be classed as an extra large eccentric chuck. It is constructed in a similar manner but is capable of more extended movement, having a total travel of 5 in., 2 in. above centre and 3 in. below centre. The lead-screw can be operated from either end for convenience. The wormwheel with a copy of the mandrel nose has 120 teeth against the 96 teeth on others. Being a heavier and stronger chuck than most it carries other chucks mounted on its nose with less chance of vibration than others.

When used in conjunction with the segment apparatus it becomes in reality a shaping machine



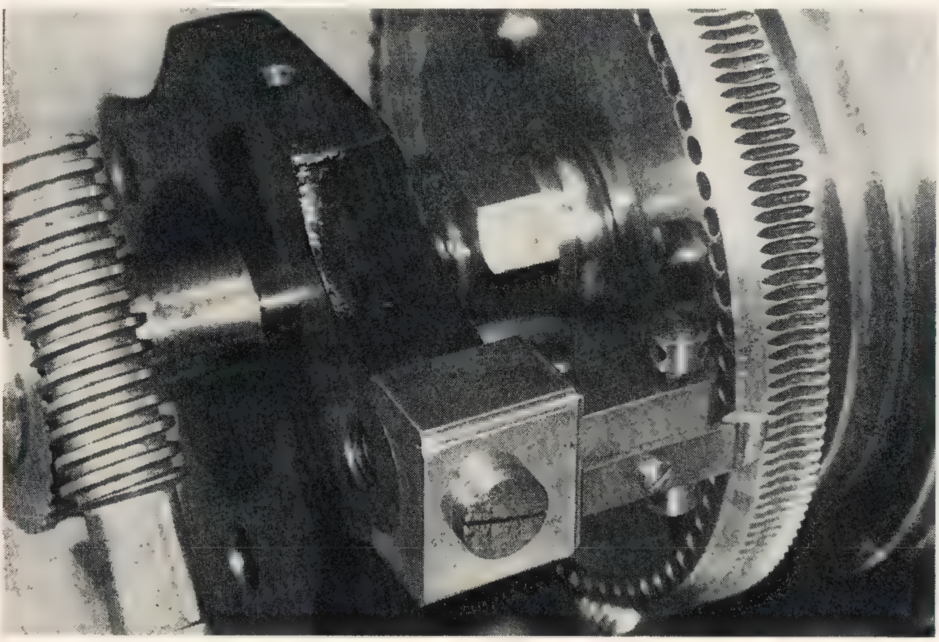
A close-up of the reversing bevels of the spiral apparatus.

and can produce examples of beautiful work, such as Gothic arches, moulded bases, etc.

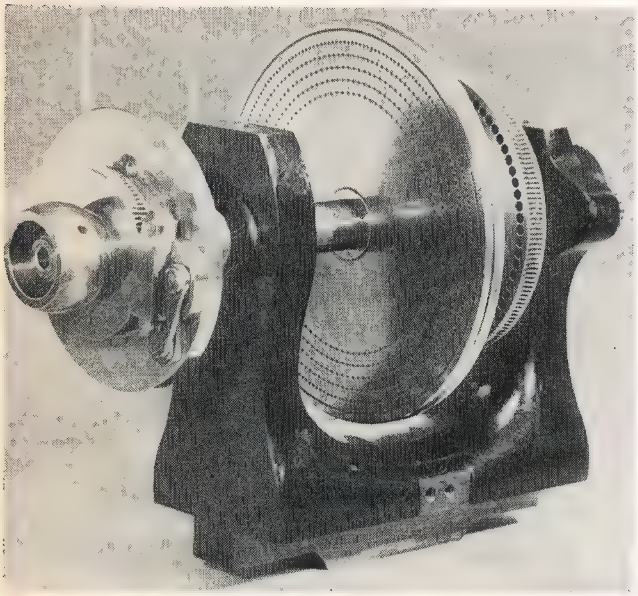
The arbor chuck

This chuck bears some resemblance to the expanding mandrel and is used to support work having central holes. It has a large flange to square up the work and a long arbor to pass through hollow work of varying thicknesses. There are a number of washers varying in thickness with a coned washer for centralising the work.

There are sixteen screw chucks, eight having



Another close-up of the spiral apparatus.



The centre screw chuck on the headstock.

male threads and eight with female threads. The body is of bronze screwed to fit the mandrel nose. Many articles are manufactured in two or three sections screwed together and these chucks can be very useful in treating each section.

Bell chuck

For holding odd-shaped pieces. A cast bronze hollowed body with four steel bolts for securing the work.

The prong chuck has a heavy bronze body threaded for mandrel nose with steel insert having a central prong with chisel-shaped driving prong either side of the prong.

Spring chucks

These are beautifully and precisely made. There are eleven of them ranging in size from $1\frac{1}{2}$ in. to $4\frac{1}{2}$ in. in diameter. The bronze body is hollowed out with a turned step to suit the work. There are several horizontal saw slits and the outside is slightly tapered. Each chuck is provided with a tapered steel closing ring to clamp the work.

Cement chucks

There are six of these in sizes $1\frac{3}{4}$ in. to 4 in. dia. Work of a delicate nature, which can be easily damaged, is secured by a cement comprising resin, wax and fine powder such as pumice. Alternatively sealing wax can be used or shellac either alone or mixed with finely powdered pumice stone.

The universal chuck

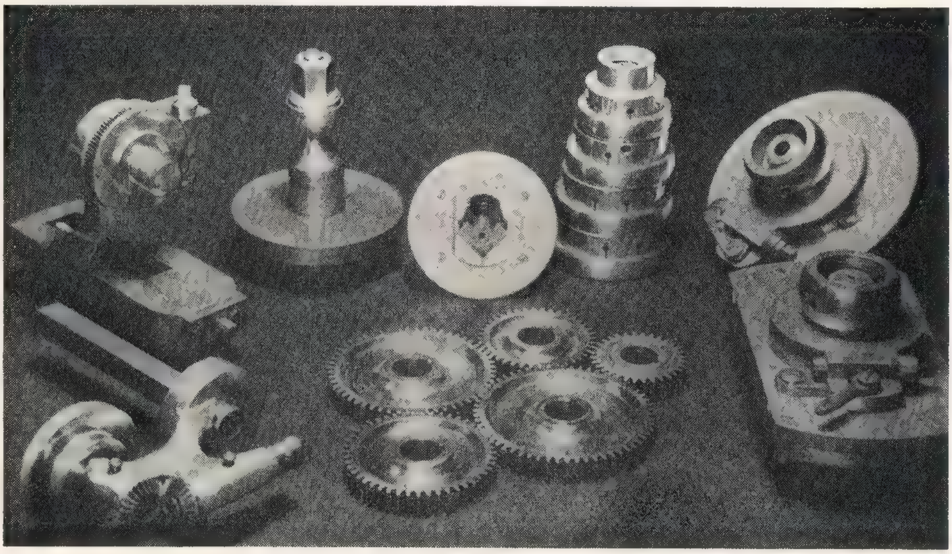
A large two-jaw self-centring chuck weighing almost 15 lb. The steel jaws are reversible and operated simultaneously by a single screw the two halves of which are left and right hand threads. The bronze body is $9\frac{1}{2}$ in. dia.

The die chuck

This beautiful little chuck deserves special mention. It can hold round stock both concentrically and eccentrically in sizes 1/32 in. to 1 in. dia. and is constructed in a most ingenious manner. The bronze body is machined all over and has V guides to take the centre assembly which consists of a hardened steel block having two Vs. This block is reversible to present a small V or a large V to the centre for small or larger round stock. The material centres on the V and can be moved to either side of centre or on centre and locked in position with a large headless screw.

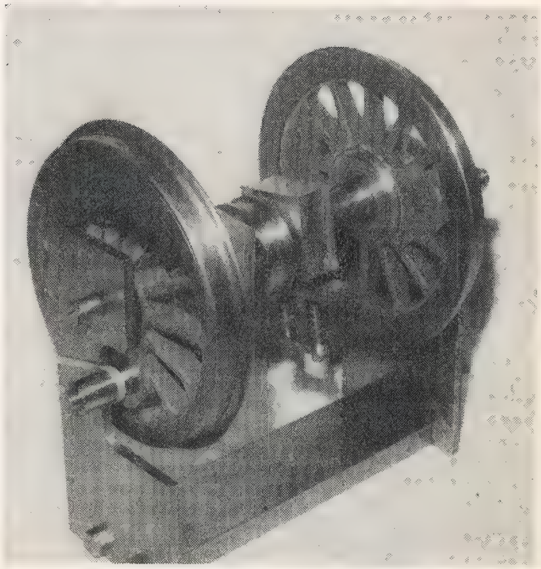
To be continued

In the back row are the dome chuck, the arbor chuck, the die chuck, 4 spring chucks and the centre screw chuck. In the foreground: the horizontal cutting frame, a group of bronze gears and the oval chuck.



ANOTHER JIG for WHEEL QUARTERING

by K. D. Hornsby



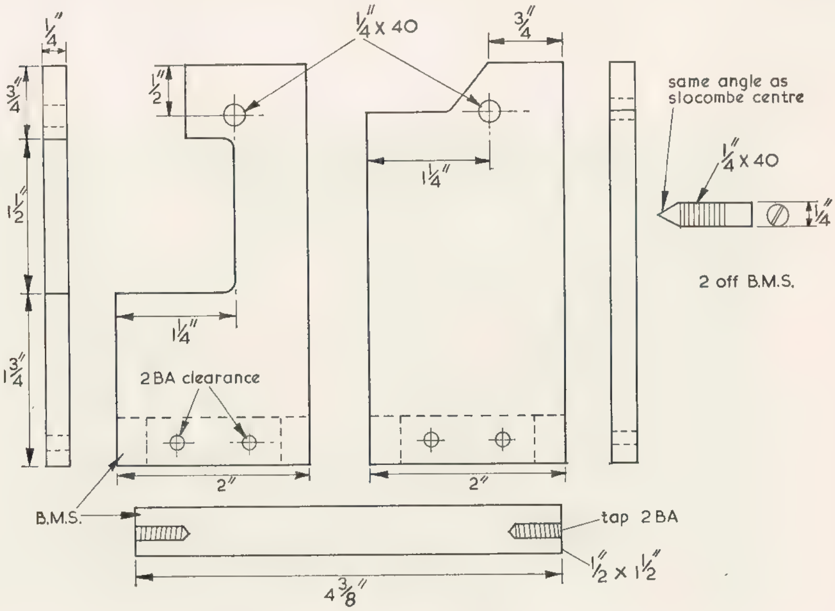
OVER THE YEARS there have been a good many ideas put forward for accurately quartering small locomotive cranks. With the (I hesitate to suggest) old fashioned method of a good press fit, a slight margin of error can creep in with the last squeeze.

With the use of Loctite, which I have found to be completely successful, it is possible with a simple jig to set up cranks and axles so that all are at identical angles. I feel that $3\frac{1}{2}$ in. gauge locomotives are about as heavy as I can tackle and the jig can be used for all the future ones I ever build.

The locking qualities of Loctite are beyond question. With one of my pairs of wheels I was not quite quick enough getting the cranks on the jig registers. The Loctite went off before I could get them both snug and I had a difficult job getting a wheel off again. It needed a good heat up with a blow-lamp and some hefty thumps with a hammer and brass punch. It is quite remarkable stuff, the only essential is cleanliness. I use carbon tetrachloride to clean mating parts.

The jig consists only of three pieces of flat bright mild steel, four 2 BA bolts and a couple of pointed, screwed spigots. The base plate should be fairly hefty, $\frac{1}{2}$ in. x $1\frac{1}{2}$ in. x $4\frac{3}{8}$ in., and it must be squared accurately at both ends. Use a milling attachment on the lathe or like myself on a milling machine. (I made a Dore-Westbury M.E. Services machine, T piece and mandrel casting all fixed with Loctite.) The two end pieces are also flat b.m.s. 4 in. x 2 in. about $\frac{1}{4}$ in. thick. The screwed spigots are lengths of $\frac{1}{4}$ in. round b.m.s. pointed off at one end at the same angle as a Slocombe Centre.

I used a $\frac{1}{4}$ in. x 40 T.P.I. die to cut the threads, opened out as far as possible so that the screws



WHEEL QUARTERING JIG

are snug in the tapped holes in the end plates. One of these can be left protruding inside one of the plates. If only one is screwed in and out to pick up the axle centres the margin of error is reduced. It is of course essential that the axles are turned between centres and, as is normal, the centres left on the ends. It is best to mark off the end pieces on a faceplate. The vertical register is marked 1¼ in. from one edge and the horizontal register ½ in. from the top.

The two pieces should be clamped together for drilling, making sure that they are true with each other. The top hole is drilled spot-on at the intersection of the register lines for ¼ in. x 40 T.P.I. The two holes at the bottom are drilled No. 25. The two plates are then separated and milled to the marked register lines and also squared off truly at both ends.

Next clamp them to the base plate, making quite sure that all three pieces are square with each other. Use a faceplate or lathe bed for this, and drill the four No. 25 holes through each end plate into the base plate about ½ in. deep. After taking them apart, the holes in the end plates can now be opened out to 2 BA clearance No. 13. Using the end plate holes as a guide, tap the holes in the bottom plate 2 BA. All three pieces can now be bolted together using high tensile bolts if available, making sure that they are square with each other while tightening.

To assemble the wheels and axles, one wheel should be fixed first with Loctite and allowed to cure. Slip hornblocks and eccentrics and the other wheel with its coating of Loctite on both wheel and axle. Set them up in the jig, screwing in the centre screw with no play on the axle centres, also make sure that the wheel is tight back against the axle shoulder, slip rubber bands over the journals so that they are snug against the 90 deg. registers and allow to cure. The varying diameters of the crank pin journals will make no difference to the 90 deg. pitch, they will compensate each other.

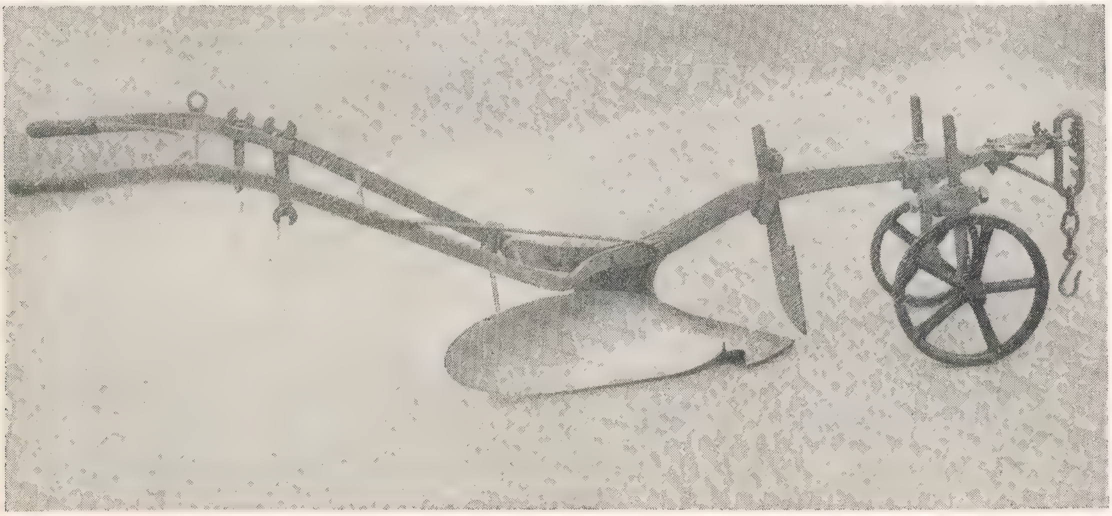
A Model Horse-drawn Plough

by L. R. Turner

I FIRST BECAME interested in this project when I noticed that a drawing of a horse-drawn plough in the book *Ploughing by Steam* was of the same type as an old plough standing in a relative's farmyard.

I wanted a working drawing to be the same size as the model, which would be 1/10th full size to match a pair of porcelain shire horses made by Beswick, these working out to be approximately 1/10th lifesize. As the drawing in the book was 1/20th full size I made the first part of my plan with the aid of a pantograph set at 2 to 1. Details were then added from information gleaned from the old plough. No castings were used in the model, the various parts being cut from b.m.s. plate and forged to shape.

Old ploughs seem always to have been built with square-headed bolts and square nuts. In this example they were ⅝ in. dia. which worked out to 10 BA in the model. I made the spanners first and used them as gauges when filing the squares, thus ensuring a good fit. Plough wheel spokes have a rib on the outer face and I tried for this effect by soldering a half-round piece (half a 1/16 in. dia. split pin) on each spoke. The blocks for adjusting the wheel



position are fabricated from four pieces after the square holes have been forged and fitted to the ⅛ in. sq. bars, the set screws in them being 8 BA. The crossbar passes through an eye bolt which clamps it to the beam. The quadrant and rack at the front are to allow a bit of bias to be put on the draught both laterally and vertically. The breast or mouldboard is pivoted on a countersunk bolt at the front just behind the share and held at the rear by an adjustable stay, the setting of which governs the width of the furrow.

I stamped the name *Bantam* in 3/32 in. letters and *Ransomes, Ipswich* in 1/16 in. letters which look about the right size. The model is finished in light blue, with wheels and back of breast red, lettering being picked out in yellow; a livery vouched for by an elderly farmer friend.

The wipple-trees are of oak, varnished, and the traces were once a necklace. I gave the horses a coat of Humbrol matt varnish which resulted in a more lifelike appearance, and copied the harness from that which I've seen at rallies. The harness on the model is made of black plastic with brass names and mounts.

The photographs are by J. G. Glydon.

CLUB DIARY

Dates should be sent at least five weeks before the event to ensure publication. Please state venue and time. While every care is taken, we cannot accept responsibility for errors

FEBRUARY

20 Romford M.E.C. Talk or films. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.

20 Rochdale S.M.E.E. Slide Night. Technical College. 7.30 p.m.

20 East Sussex Model Engineers. Meeting. Mercatoria Hall, Mercatoria, St. Leonards-on-Sea, East Sussex. 7.45 p.m.

20 Ickenham & District S.M.E. 5" & 56½' by L. J. Greene. Rear of Coach & Horses, Ickenham. 8 p.m.

20 Stockport & District S.M.E. Hot Pot Supper and Film Show. Wellington House, Wellington Road North, Stockport. 8 p.m.

21 Hull S.M.E. Model Show—Organised by the Kingston Lions. City Hall.

21 S.M.E.E. Rummage Sale. Marshall House, 28 Wanless Road, London SE24.

23 Clyde Shiplovers' & Model Makers' Society. "I just happened to be there"—Sydney Sharman. Partick Halls, Burgh Hall Street. 7.30 p.m.

23 Worthing & District S.M.E. Informal Evening. Broadwater Hall. 7.30 p.m.

23 Willesden & West London S.M.E. Small Gauges (O to Z). Kings Hall Community Centre, Harlesden Road, London NW10. 8 p.m.

24 Sutton Coldfield & North Birmingham M.E.S. Oxy-Acetylene Welding Practice by Mr. J. Englefield. Co-operative Meeting Room, 286 Brookvale Road, Erdington, Birmingham 23. 7.30 for 8 p.m.

25 Bristol S.M.E.E. Peter Dupen—999. British Rail Staff Association Club, Temple Meads. 7.30 p.m.

25 Sutton Coldfield Railway Society. Night Mail—Bill Thornber at the projector (cine). Wylde Green Library, Emscote Drive, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

25 Harrow & Wembley S.M.E. Marine. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m

25 Cannock Chase M.E.S. Open Evening.

26 Hull S.M.E. Wartime memories of the Italian State Railways given by J. M. Proud. Trades & Labour Club (Room 3). 7.45 p.m.

26 Sutton M.E.C. Hints and Tips. Members' lecturettes. Clubhouse, Chatham Close, Woodstock Rose, Sutton, Surrey. 7.30 for 8 p.m.

27 Brighton & Hove Society. Bulleid Pacifics. Elm Grove School, Elm Grove, Brighton. 8 p.m.

27 Kinver & West Midlands S.M.E. Workshop Technology. Clubhouse, Kinver.

27 Ickenham & District S.M.E. "Films—Scotland & Continental Railways" Rear of Coach & Horses, Ickenham. 8 p.m.

27 Merchant Navy Locomotive Preservation Society. "Rebuilding the Bulleid Pacifics"—Mr. R. Jarvis who, along with Mr. Swift was responsible for the rebuilt design, recalls the whys and wherefores. Pillbox, Westminster Bridge Road, Waterloo SE1. 7.15 p.m.

27 Dublin S.M.E.E. "Horology" by Mr. M. Ryan. City Quay Schools, Dublin 2. 8 p.m.

28 North London S.M.E. Dinner Dance—Cockfosters.

MARCH

1 Stafford & District M.E.S. Slide show by Mr. D. Bradbury. Riverside Centre, Stafford. 7.30 p.m.

1 City of Leeds S.M.E.E. "One Man Show" by Mr. R. Jeffrey, arranged by Mr. G. Jackson. Salem Congregational Church, Hunslet Road, Leeds 10. 7.30 p.m.

3 Sutton Coldfield Railway Society. Layouts and Exhibition briefing. Wylde Green Libraries, Little Green Lanes, off Birmingham Road, Sutton Coldfield. 7.30 for 8.15 p.m.

3 Harrow & Wembley S.M.E. Committee Meeting. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.

3 Guildford M.E.S. Railway films by Mr. Potter.

4 Rugby M.E.S. Roger Marsh of Minimum gauge railways on modelling in larger scales.

4 High Wycombe M.E.C. Model Display Evening. Bassetsbury Manor, Bassetsbury Lane, High Wycombe, Bucks.

4 Leyland, Preston & District S.M.E. Meeting. Roebuck Hotel, Leyland Cross, Leyland, Lancs. 8 p.m.

4 Glasgow S.M.E. Heavy Haulage by Steam—talk by Mr. T. McTaggert. Museum of Transport, 25 Albert Drive, Glasgow. 7.30 p.m.

4 Sutton M.E.C. Members' work. Clubhouse, Chatham Close, Woodstock Rose, Sutton, Surrey. 7.30 for 8 p.m.

5 Ickenham & District S.M.E. "Locomotive Control and Transmission Systems" by F. C. Matthews. Rear of Coach and Horses, Ickenham. 8 p.m.

5 Winchester M.E.S. "Rail 150" and other films at 9 St. Stephens Road, Weeke.

5 Romford M.E.C. Ardleigh House Community Centre, Ardleigh Green Road, Hornchurch, Essex. 8 p.m.

5 East Sussex Model Engineers. "Bits and Pieces" and "Bring & Buy". Mercatoria Hall, Mercatoria, St. Leonards-on-Sea, East Sussex. 7.45 p.m.

5 Rochdale S.M.E.E. Models Night. Technical College. 7.30 p.m.

5 Stockport & District S.M.E. Bits and Pieces. Wellington House, Wellington Road North, Stockport. 8 p.m.

6 S.M.E.E. Chairman's Inaugural Address. Marshall House, 28 Wanless Road, London SE24. 2.30 p.m.

6 & 7 Sutton Coldfield Railway Society. Model Railway Exhibition. At least 5 working layouts—model engineering—railway preservation—refreshments. Brampton Hall, Princess Alice Drive, Chester Road North, New Ostcott, Sutton Coldfield, West Midlands. Saturday 10 a.m. to 8 p.m. Sunday 11 a.m. to 6 p.m.

8 King's Lynn & District S.M.E. Meeting.

8 North Wales M.E.S. Meeting. Penrhyn New Hall, Penrhyn Bay, Llandudno. 7.30 p.m.

8 Bedford M.E.S. Group Discussion, Boiler Making. Bunyan Meeting Hall, Goldington. 7.30 p.m.

8 Worthing & District S.M.E. Auction Sale. Broadwater Hall. 7.30 p.m.

8 Clyde Shiplovers' & Model Makers' Society. Magazine Night. Kelvingrove Art Gallery and Museum. 7.30 p.m.

9 Sutton Coldfield & North Birmingham M.E.S. Open Night. Co-operative Meeting Room, 286 Brookvale Road, Erdington, Birmingham 23. 7.30 for 8 p.m.

9 Guildford M.E.S. Executive committee meeting.

9 Derby S.M.E.E. "British Railways" Film show. C. & W. Welfare, Derby.

9 Brighton & Hove Society of Miniature Locomotive Engineers. S.A.M.R.C. A.G.M. and Meeting at Burgess Hill.

10 Bristol S.M.E.E. Sam Robinson—Trials and tribulations of Mill Engine builders. British Rail Staff Assoc. Club, Temple Meads. 7.30 p.m.

10 Southampton & District S.M.E. Finals of photographic competitions. 8 p.m. Atherley Bowling Club, Hill Lane, Southampton.

10 Harrow & Wembley S.M.E. Slide Competition. B.R. Sports Pavilion, Headstone Lane. 7.45 p.m.

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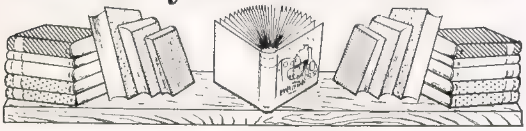


"Top Shed" by P. N. Townsend

Published by Ian Allan Ltd., Terminal House, Shepperton, Surrey.
175 pp. Price £4.50.

The King's Cross locomotive depot was familiarly known as "Top Shed", and in the old steam days it was a fascinating if dirty place for the enthusiast! It had a career lasting from 1850 to 1963, when the Diesel depot at Finsbury Park brought about its closure.

The author was himself in charge of the depot from 1956 onwards, so was in an ideal position to tell its story, which he has done with painstaking thoroughness.

The illustrations are excellent, many of the photographs being quite new to this reviewer, and there are some interesting drawings showing the different exhaust arrangements used on the streamlined "Pacifics".

No steam enthusiast should miss this book. R.M.E.

"London Steam in the Fifties" by Brian Morrison

Published by Ian Allan Ltd., Shepperton, Surrey.
218 pp. Price £3.60.

This is a pictorial survey of steam locomotives that could be seen in the London area in the 1950's, and it is perhaps surprising how many early types of engine that were still at work during that period. For instance, J.17's of the L.N.E.R. (ex-Great Western) then over 50 years old but still going strong, Billinton 0-6-2 tanks, Wainwrights D class of the old S.E.C.R., Johnson class 1F 0-6-0T of the 1880 period and ex-Manchester, Sheffield & Lincolnshire Railway 0-6-2 tanks of 1891.

The photographs are generally good and the quality of the paper used excellent. R.M.E.

"Engines" by Arthur Conway

Published by Macdonald Educational, St. Giles House, 49-50 Poland Street, London W1A 2LG.
64 pp. Price £1.50.

This is the third title in the series "Introduction to Technology" and deals with heat engines from first principles, the working of petrol, diesel and steam engines, also turbines being explained by coloured diagrams. A useful book for schools and junior students. R.M.E.

"Motor Buses in London 1904-8" by R. W. Kidner

Published by the Oakwood Press, Old School House, Tarrant Hinton, Nr. Blandford, Dorset.
46 pp. Price 90p.

This is number 85 in the "Locomotion Papers" and covers the interesting period from the beginning of the mechanically propelled bus to 1908, when there were no less than 1067 power-driven buses on London streets. During the five years under review, 31 companies tried to run these buses, but by the end of 1908, this number had been reduced to 9.

The booklet contains many interesting photographs of these early buses. R.M.E.

"The Undertype Steam Waggon"
by Maurice A. Kelly

Published by Goose & Son Publishers Ltd., 9a Victoria Street, Basingstoke, Hants., RG21 3BT.
242 pp. Price £12.50.

This book has been produced as a companion volume to the same author's "The Overtype Steam Road Waggon". It is a most comprehensive work and deals with all the steam wagon builders in this country, and some of the overseas builders, such as the Pritchard Steam Power Pty. Ltd., of Australia, Valentin Purrey of France, Dias Fahrzeugbau G.m.b.h. and Henschel und Sohn of Germany.

The various designs of boilers, engines and chassis are fully described, together with many photographs and drawings, and the details provided include in many cases works numbers of the wagons, customers' names, delivery dates, in addition to technical specifications and performance data.

A notable work. R.M.E.

"Baguley Locomotives, 1914-1931"
by Rodney Weaver

Published by the Industrial Railway Society, and obtainable from I.R.S. Publications, 47 Waverley Gardens, London, NW10 7EE.
96 pp. Price £2.

The Shobnall Road Works of Baguley at Burton-on-Trent was one of the smallest in Britain to build locomotives. Only a very few steam locomotives were built by the firm, but their internal combustion locomotives were generally highly successful and ranged from tiny 2 ft. gauge 6 h.p. petrol locomotives supplied to the Ministry of Munitions, to a single 5 ft. 6 in. gauge 0-4-0 of 125 h.p. built for Malaya in 1928.

The work is well illustrated and contains a comprehensive Works list giving details of dimensions, mechanical features, customers, etc. There are also drawings of the interesting Baguley patented transmissions and valve gears. R.M.E.

"The Great Eastern Railway" by Cecil J. Allen

Published by Ian Allan Ltd., Shepperton, Surrey.
240 pp. Price £1.80.

"Railway Race to the North" by O. S. Nock

(*published by Ian Allan Ltd.*)
168 pp. Price £1.40.

"The Lancashire & Yorkshire Railway in the Twentieth Century" by Eric Mason

(*published by Ian Allan Ltd.*)
236 pp. Price £1.95.

The above three books are paperback editions of works originally published in 1955, 1959 and 1954 respectively. R.M.E.

"British Rail Main-line Diesels, compiled by S. W. Stevens-Stratten, drawings by R. S. Carter.

Published by Ian Allan Ltd.
63 pp. Price £3.30.

The work presents a set of drawings to 4 mm. scale of B.R. diesels, together with two photographs of each locomotive, some technical data and painting details.

The book will be very useful to the model maker. R.M.E.

The Editor welcomes letters for these columns. He will give a Book Voucher for £3.00 for the letter which, in his opinion, is the most interesting published each month. Pictures, especially of models, are also welcomed. Letters may be condensed or edited.

2½ in. Gauge

SIR,—Now that our postal strike in Canada is over, may I make a few observations on 2½ in. gauge, after reading your report of the Cheltenham & Bristol S.M.E.'s Rally in the August 1st issue? I was surprised to find that there appear to be only 11 clubs with track facilities for this gauge in Britain. I have long felt that this gauge has been neglected and, in some cases, deliberately ignored—unfairly so in the latter case.

Some of the comments I have heard about ½ in. scale locomotives range from "watchmaking" to "too small to do any sensible work" or "too much of a problem to keep the fire going" or "they wear out too fast" etc., etc. When you boil it down to hard facts, most of these comments come from people who have never built or driven a 2½ in. gauge locomotive. So let's not knock something without personal experience. Your report on the 2½ in. gauge rally should show that locomotives in ½ in. scale (or narrow gauge locomotives of larger scale on this gauge) are reliable, can do useful passenger hauling, can go all day if needed, can be built in accurate scale and look really good, can show considerable turns of speed.

Let's look at a few other points in favour of this scale and gauge. Inflation today has put costs of castings and materials up astronomically everywhere. Castings for 2½ in. gauge locomotives are a lot less costly than for larger gauges. As boilers are smaller, one needs less expensive copper for this item. The average 2½ in. gauge tender locomotive is well within the handling and lifting capacity of the average person. It can even be safely lifted by some who are partly incapacitated or barred from lifting heavy weights. They are small enough to be transported easily.

The whole purpose of our magazine, our clubs, and the general activities of model engineering, is to bring enthusiasts together to foster and encourage interests in all branches of this fascinating hobby, yet the vast majority of clubs ignore the gauge altogether, dismissing it with comments like those mentioned earlier, which are unfair.

Machinery costs are very high now too. Consider the youngster just starting work, who wishes to start in locomotive building, but whose pocket is not yet deep enough to stretch to an ML7 or even an ML10—especially when other items like drills, grinders, etc., not to mention all the other tools needed, have to be paid for too. Then what about the newly retired person, now on a fixed income, who would like to take up a hobby that he may not have been able to while working. 2½ in. gauge locomotives would be reasonably in the pocket range for these people. Surely they are entitled to the same consideration and encouragement from clubs as are the supporters of the larger gauges?

2½ in. gauge locomotives are fun to drive and they perform very well. I have shared the driving of a 2½ in. gauge Pacific that was in steam from 10 a.m. to 7 p.m. stopping only for water, coal and oil and to change passengers. The average load was 7 adults and we didn't have even the smallest spot of trouble—it went better than some of its larger rivals.

On the question of difficult firing; if the firehole door is made large enough, and a sensible shovel is designed for it, it shouldn't be any more difficult than any other locomotive. I can be pretty ham-fisted and I found it easier to fire than a 3½ in. gauge *Juliet* that bounced about like a cork in a rough sea. (One can also use oil firing—or propane).

One other consideration, 2½ in. gauge is small enough to allow a track in one's garden, where the larger gauges either allow only an up and down or one suitable only for an 0-4-0 or a very short wheelbase 0-6-0. If a narrow gauge prototype is modelled, one can take very tight curves with these. A good example is a locomotive built by W. G. Bagnall for a 2 ft. 6 in. gauge railway in India. This is a 2-6-2 tender locomotive with outside Walschaerts gear and outside frames.

In 1 in. scale for 2½ in. gauge, it would be approximately 40 in. long by 7 in. wide and 9 in. high. The fixed wheelbase is only 6½ in. and it could comfortably manage an 11 ft. to 12 ft. radius curve—probably even tighter. Don Young's Mountaineer in 2½ in. gauge would be a good one too.

I do most earnestly appeal to clubs to give encouragement to people in this gauge and to try and foster further interest in it instead of condemning it as useless as many seem to do. If more clubs had a 2½ in. track, more members might give serious consideration to building in it now that costs have risen so much.

Before the clubs shout that inflation has made it too expensive for them to afford the extra rail, I'm not suggesting immediate fitting of the whole track. It can be done gradually, over a year or two. I honestly feel that some of the larger, more prosperous clubs could take a lead in this area to give some encouragement in this field. Come on club members, you can't expect anyone to take much interest in the gauge if there is nowhere for them to run. I have written to "Live Steam" in U.S.A. on this matter in an attempt to boost interest over here too. A number of clubs have a 2½ in. gauge track, but seem to be in a similar proportion to those in the U.K. who have them. Perhaps our worthy Editor could see his way to publishing a construction series on a 2½ in. gauge locomotive—maybe a reprint on *Austere Ada* or *Fayette* if not a new design. Or how about the W. A. Bagnall locomotive mentioned earlier? Some encouragement from the magazine might help too.

In closing, I would very much like to hear others' views on this subject. Maybe readers who attended the 2½ in. gauge Rally at Cheltenham could give some constructive views on the matter. Inflation is giving us all a bashing so let's make a real effort to get some interest in a more economical section of our hobby. I'm in 3½ in. gauge at present, but would soon build in 2½ in. gauge if I had somewhere to run.

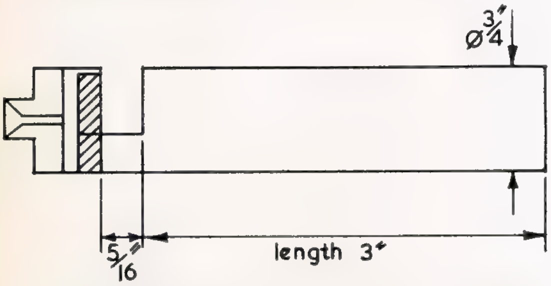
Ontario, Canada. — N. Tyler

Whistles

SIR,—In response to Mr. F. R. M. Lawrence's letter on whistles, I make the following observations. The most common fault of whistles fitted to models is the production of light harmonics rather than the fundamental tone when operated at high pressure. To avoid this, a whistle needs to be made less like an organ pipe and more like a Helmholtz Resonator, i.e. short and fat.

The Helmholtz Resonator is a hollow sphere with the

distinctive property that it is capable of producing only one tone with no harmonics. Consequently, if a deep tone is required, it is not sufficient to lengthen the whistle but the diameter must be similarly increased. The resonator of LBSC's deep tone whistle is a good approximation to a Helmholtz Resonator, but it is easier to make the whole whistle fatter and avoid the need to match the whistle and resonator.



Another common fault is that model whistles are feeble. To make a loud whistle, the width of the air, sorry, steam passage and hence the length of the edge which excites the tone should be made rather longer than the usual LBSC pattern and the distance between the jet and the edge rather smaller, the whole aperture being rectangular. The sketch shows the proportions for a whistle to produce a good loud B6 (about middle C) and take a lot of steam before producing harmonics. The design may be scaled for differing pitch and successful length to diameter ratio's are between 2:1 and 5:1. The method of construction is otherwise as spelled out by LBSC.

Camberley, Surrey. P. Gardner

Proportional (or scale) dividers

Sir,—Mr. J. L. Allan's letter in *M.E.*, 5 December 1975 refers to an "Unusual pair of dividers'. He may be interested to know that these were still in production until quite recently, and indeed probably still are! I have in my possession a modern, Service issue set with precisely similar markings. The purposes of the various scales are quite simply:

LINES	direct ratio as set
AREAS	Scales areas as set—i.e. a linear scale factor the square root of that set
VOLUMES	Scales volumes as set—i.e. a linear scale factor the cube root of that set
CIRCLES	Gives the circumference of the circle when set to diameter, divided into the set number of portions.

Hoping this is of interest to Mr. Allan and possibly other readers.

Torpoint, Cornwall.

S. J. Hunt, B.Sc., Lieutenant, Royal Navy

Titan tractor

Sir,—I was most interested to see the excellent cover picture of an International Titan tractor. These were imported from the U.S.A. during the first war and I bought one later for £7, which I used for farm work. The Titan had a horizontal 2-cylinder engine of 8½ litres capacity, which developed 20 b.h.p. at 500 r.p.m. The 2 bearing crank had a single throw, so both pistons travelled side by side and the 3 ton vehicle rolled to and fro on its wheels in sympathy.

It was pretty useless for ploughing, because its vast weight caused it to sink down to Australia on wet ground, and its maximum speed was a slow walking pace, it took half a day to fetch it back from the other side of the farm. Nevertheless, it was ideal for belt work, and Titans were used for many years to drive sawbenches. Though the light, fast Fordson immediately rendered it obsolete, it would be worth modelling as an important stepping stone between steam and internal combustion on the land.

Edenbridge, Kent. J. V. Bolster

Titan tractor

Sir,—Your cover picture of a Titan tractor on the January 2nd issue of *Model Engineer* struck an interesting chord in my memory. I recall that whilst cleaning out an attic room at my first place of work (which had previously been occupied by a supplier of agricultural machinery) I became interested in the contents of some pages from the "operators' manual" for one of these engines. The instruction which amused me and has remained locked in my memory ever since was that which, having got the engine started, presumably on gasoline, and switched over to kerosene, the water feed to the induction system should be slowly turned on "until knocking and pounding ceases". Evidently in those days instruction manuals were written by honest down-to-earth engineers; and making a virtue out of necessity by referring to the process as a brilliantly engineered feature designed to "suppress detonation caused by the use of inferior fuels in the efficient high compression engine".

Hampton Hill, Middx. H. W. Holmes

Exhibition of Electric Clocks

Sir,—During the last five years the Electrical Horological Group of the Antiquarian Horological Society has successfully established for posterity some record of the history of the developments in electrical timekeeping. Vast changes have, and are, continuing to take place in electrical timekeeping. Whilst it is saddening to see the demise of the artistry and superb work of the hand craftsman, it must not be denied that there is interest to be obtained from studying the tremendous field of technical progress that has taken place in the last hundred and fifty years. The explosion has now taken place and the Group are hard at work collating scraps of information; often from many obtuse and diverse sources. It is, therefore, with very great pleasure that the Electrical Group have accepted the invitation of the Science Museum to join them in organising an exhibition to demonstrate the development of the electric clock and also to commemorate the centenary of the death of Alexander Bain in 1877.

The Exhibition will fall into three main groups:

1. Pre-Bain and Bain
2. Bain and up to the electronic era
3. Electronic and subsequent development.

We would particularly wish to include in this Exhibition items which are not normally to be seen in the Time Gallery at the Science Museum. There may well be many interesting clocks in private hands and it is these clocks that would form and enhance the Exhibition generally. Should anyone feel that he may possess some interesting item which would help tell the story or paint the picture to the general public, I should be pleased to receive details which would then be submitted to the Exhibition Advisory Committee for consideration.

148 Percy Road, Whitton, Middlesex TW2 6JG.

F. G. Alan Shenton
Chairman of the Electrical Horological Group
of the Antiquarian Horological Society

Corliss Engines

Sir,—Could any of your readers help me in some research that I am doing on the Corliss Engine Co. and the Philadelphia Centennial Corliss Engine.

Any information or any sources of information would be helpful.

635 East 111th Street, Chicago, Ill. 60628.

F. H. Beberdick

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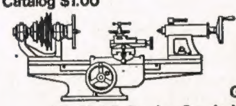

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